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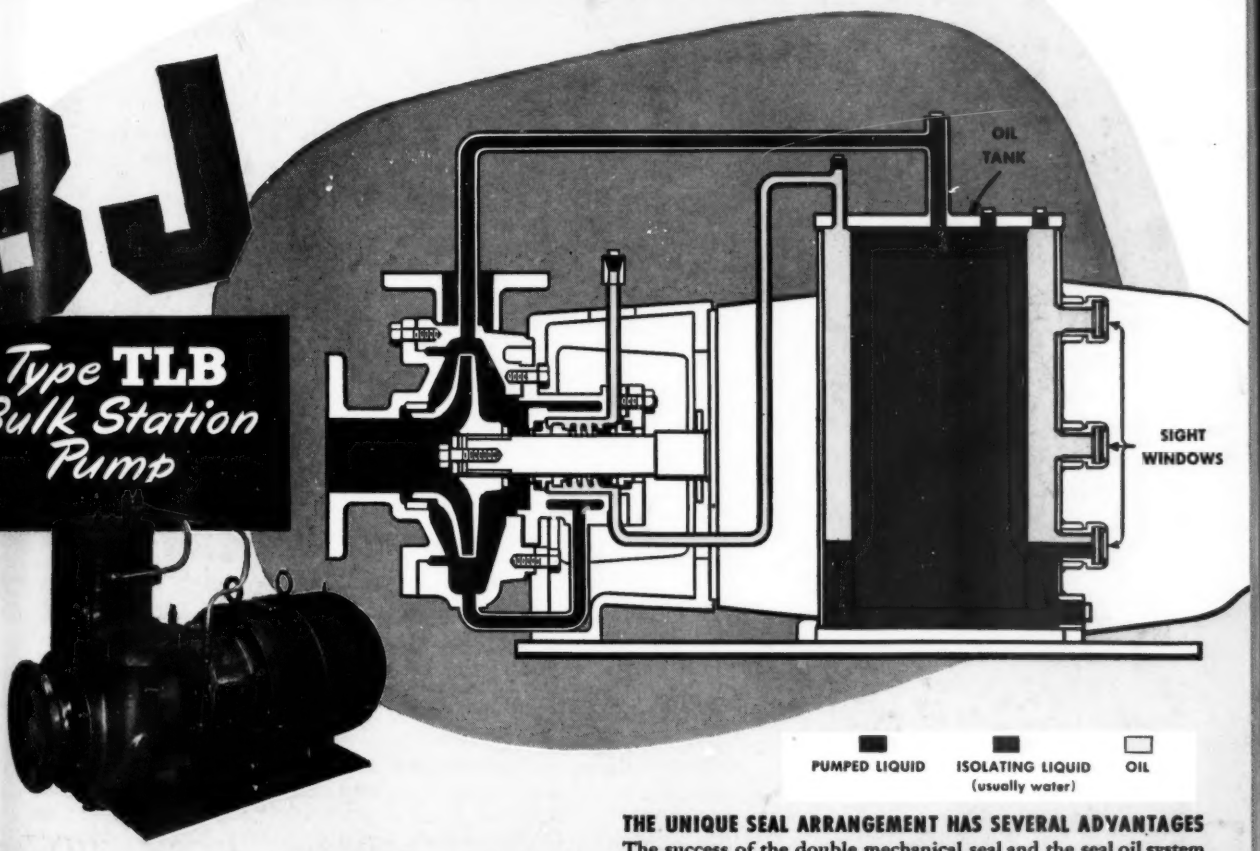
BJ

Type **TLB** *Bulk Station Pump*



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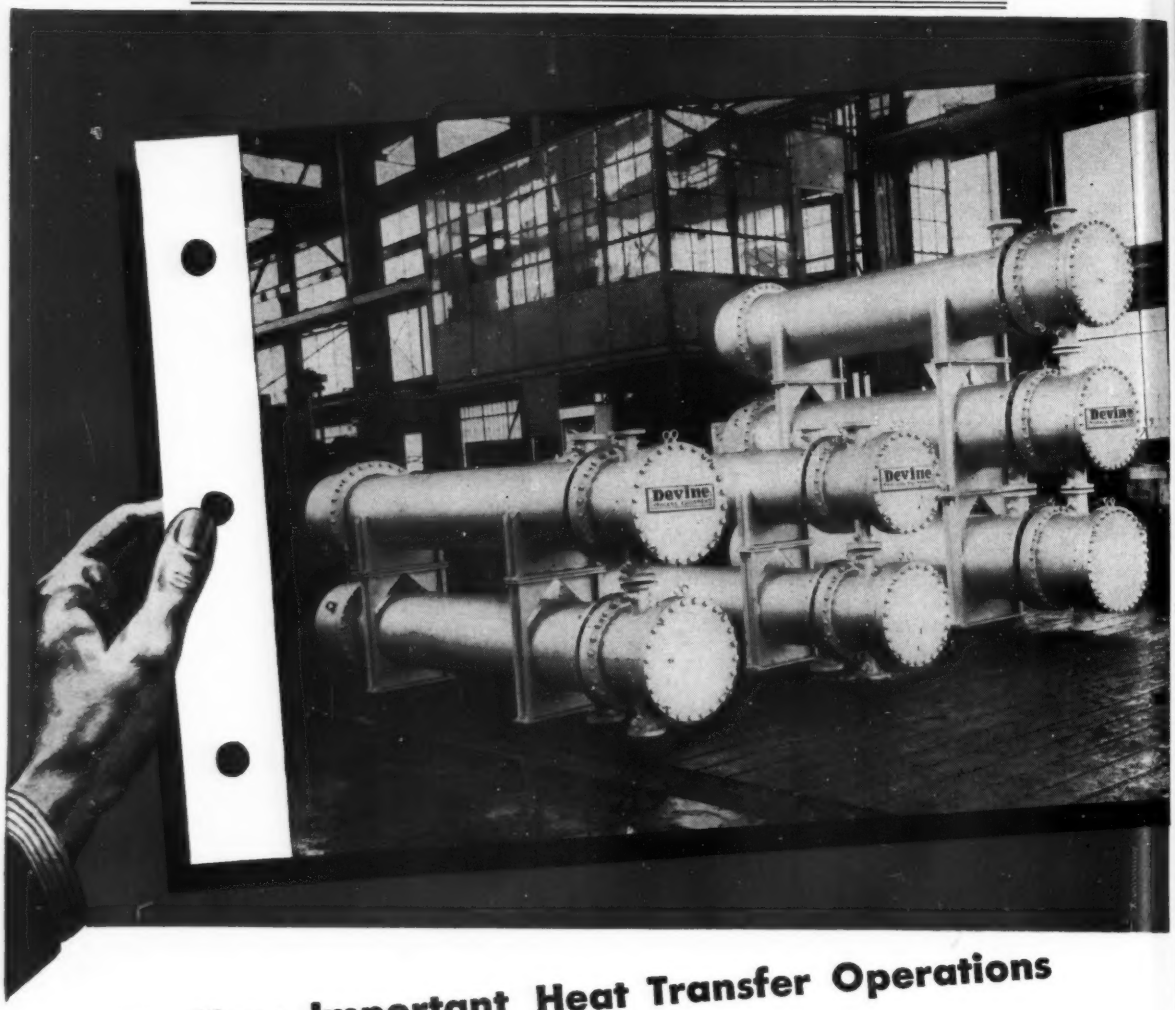

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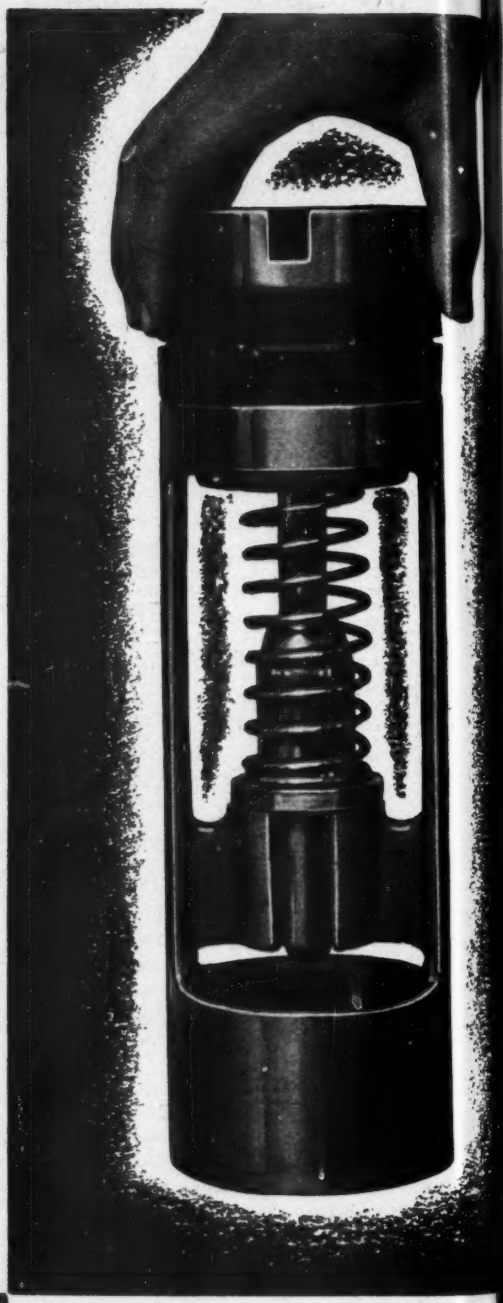

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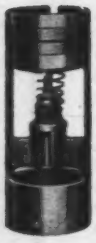

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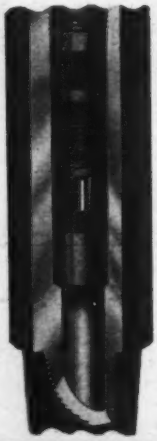
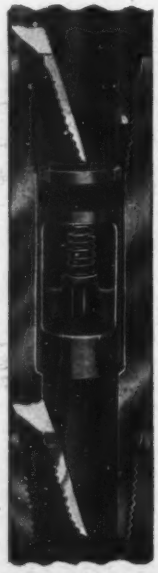


it is held in place by the tool joint pin above it. No tools or wrenches are required to install or remove.



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THE OIL AND GAS JOURNAL

A Vigorous Defense

THE issues involved in the suit brought by the Department of Justice last week against Standard Oil Co. of California, based on the contention that the various types of "exclusive dealer" arrangements violate the antitrust acts, are of major importance to refiners and distributors. It should also be kept in mind that what happens in wholesale and retail markets inevitably reacts in all markets of the petroleum industry.

It is apparent that the distributing operations of the defendant company in this test case are in line with oil-marketing practices in all areas. Furthermore, the operating methods complained of will be found in one form or another in many other industries. The question of legality has been carefully considered over the past decade by counsel within and outside the petroleum industry, and it has not been felt that either the letter or the spirit of the antitrust acts was being infringed.

The existing exclusive agreements among refiners, jobbers, and dealers are the logical result of the efforts of oil companies to maintain maximum service at minimum costs to millions of customers, notwithstanding restrictive federal and state tax legislation. Refiners have established trade names for their products based on quality, and they have also perfected all the services connected with the distribution of oil products.

The fact that all urban consumers in this country are within a few blocks and rural consumers within a few miles of a filling station stems from this pride in service and reflects competition among sellers, not monopoly.

The seller obviously must have protection in this nation-wide distribution involving investments totaling well in excess of 1 billion dollars. These agreements have enabled tens of thousands of small companies and individuals to operate as independent jobbers and dealers. Those which desire to operate without the exclusive contracts can do so and many thousands do, buying their products wherever they see fit.

The alternative would be to turn over the operation of more than 250,000 service stations to those without adequate financing and no knowledge of the oil business except in the distribution phases. If some refiners decided to operate their stations in the face of chain-store and other special taxes, the higher distributing costs would mean higher prices to consumers.

It is difficult to see where the public and independent enterprise, which the Government seeks to protect, suffer from these well-established merchandising policies of the petroleum industry, with full protection in prices, quality, and service to consumers. A vigorous defense should be the oil industry's answer to this latest attack on its operating practices.

Supreme Court Refuses Review In Interstate Natural Gas Case

WASHINGTON. — The Supreme Court Monday refused to review a decision of the Fifth Circuit Court of Appeals at New Orleans affirming an order of the Federal Power Commission reducing the rates charged by Interstate Natural Gas Co., acting as a producer and gatherer in the Monroe field, Louisiana, and selling to several pipe-line companies for transmission to other states.

This decision is looked upon by the oil and gas industry as giving FPC authority to regulate production and gathering of natural gas in spite of the ostensible intent of Congrass to deny it such authority.

The Interstate company was subject to FPC jurisdiction because while all its production and deliveries were within the State of Louisiana its own pipe line runs across the state border for a few miles and then back in, but the gas involved in this decision did not go into this line but was sold in the field to other carriers. The gas was sold at 7.39 cents per 1,000 cu. ft. and the commission ordered the price reduced to 4.66 cents, which the company said was less than its cost for part of the gas but which yielded the company 6.5 per cent return on its entire investment. The rate reduction amounted to $596,000 for 1945.

One of the three circuit court judges dissented from the majority decision of August 3, 1946, saying it nullified the plain intent of Congress to except from the act the production and gathering of gas and that if FPC has power to regulate the sale price of the producer and gatherer it can also regulate production and gathering.

Many persons feel that under this decision any oil or gas company which because of other activities is considered to be doing business in interstate commerce may be subject to FPC regulation as to the sale of natural gas, or that any natural gas which ultimately so moves may come within FPC regulation.

Michigan-Wisconsin Case Partly Reopened

WASHINGTON.—The Federal Power Commission has reopened as to a single point its order of November 30 granting a certificate to Michigan-Wisconsin Pipe Line Co. to construct a new gas line from Hugoton field to Detroit, but has not acted on the petitions of Panhandle Eastern Pipe Line Co. and the City of Detroit to reopen the entire case for rehearing.

The limited reopening relates only to Panhandle's rights to sell gas in the Detroit area claimed by it under the "grandfather clause" of the Natural Gas Act, the terms of certificates issued it by FPC, and its contracts with Michigan Consolidated Gas Co. The original order listed this subject as one for future consideration.

Panhandle has contended throughout that it has prior rights to serve the Detroit area's growing gas market, and the ultimate decision may affect the rights of other gas lines to exclusive service in their respective markets. While a majority of FPC has already decided that Panhandle does not have exclusive rights, it must now determine just what rights Panhandle does have and how they are to be protected against competition from the proposed new line.

Neither majority nor dissenting opinions in the Michigan-Wisconsin case have yet been published but are awaited with interest as disclosing the commission's reasoning in this important matter of grandfather and service-area rights.

Texas Co. Is Named In Huge Portal Pay Suit

A portal-to-portal pay suit totaling "several million" dollars was filed in Beaumont, Tex., last week against The Texas Co. on behalf of Oil Workers' International Union, local 23, of Port Arthur, Tex.

The suit, which mentioned no definite amount, seeks portal pay for approximately 3,700 members of the union employed at The Texas Co. refinery and Texaco terminal at Port Arthur since September 1, 1942.

In Washington early this week at least two Republican senators were preparing bills designed to combat the tide of portal suits, which over the nation had passed a total of $3,000,000,000. One bill was designed to bar all portal suits pending, while another sought to define the terms under which workers could qualify for portal pay.

In Pittsburgh, a new approach to the question was revealed when Rockwell Manufacturing Co., named defendant in a $6,000,000 portal suit, countered with a $15,000,000 damage suit against union leaders, seeking to recover damages from slowdowns and "admitted refusal to maintain production."

Suman Heads New A.P.I. Committee on Safety

John R. Suman, Standard Oil Co. (N. J.) vice president, is chairman of a new safety committee of the board of directors of the American Petroleum Institute. The group will direct the activities of the A.P.I. newly organized department of safety and coordinate and administer the work of all A.P.I. committees dealing with accident prevention, fire protection, and medical-advisory activities.

Other committee members named by William R. Boyd, Jr., A.P.I. president, are: K. S. Adams, Phillips Petroleum Co., Bartlesville, Okla.; R. B. Anderson, Waggoner Estate, Vernon, Tex.; Paul G. Blazer, Ashland Oil & Refining Co., Ashland, Ky.; R. G. Follis, Standard Oil Co. of California, San Francisco; P. N. Fortin, Yale Refining Co., Billings, Mont.; Alexander Fraser, Shell Oil Co., Inc., New York; E. J. Henry, Atlantic Refining Co., Philadelphia; R. Ogarrio, The Texas Co., New York; W. L. Stewart, Jr., Union Oil Co. of California, Los Angeles; W. G. Violette, Standard Oil Co. of Kentucky, Louisville; and the four A.P.I. divisional vice presidents, ex officio committee members: Jake L. Hamon, Cox & Hamon, Dallas; Robert E. Wilson, Standard Oil Co. (Ind.), Chicago; B. L. Majewski, Deep Rock Oil Corp., Chicago; and B. Brewster Jennings, Socony-Vacuum Oil Co., Inc., New York.

Bureau January Forecast Set at 4,640,000 Bbl. Daily

WASHINGTON. — The Bureau of Mines forecast of demand for domestic crude petroleum during January is 4,640,000 bbl. per day, compared with 4,677,000 bbl. in December.

The decrease of 37,000 bbl. per day is chiefly distributed among the largest producing states, as follows: Texas, 2,030,000 in January, 2,050,000 in December; Oklahoma, 375,000 in January, 380,000 in December; Kansas, 260,000 in January, 263,000 in December; California, 838,000 in January, 845,000 in December; Louisiana remains the same at 382,000 bbl. per day.

Exclusive-Dealer Contracts Target Of California Antitrust Suit

by Henry D. Ralph

WASHINGTON.—An antitrust suit to outlaw exclusive-dealing contracts of major oil companies with filling stations was filed by the Department of Justice in Los Angeles January 2 against Standard Oil Co. of California and its subsidiary, Standard Stations, Inc.

It is a civil action suit, seeking an injunction to nullify all types of exclusive-dealer contracts and prevent the defendants from taking future action to induce filling stations and garages to handle only petroleum products produced by Standard or accessories and other articles sponsored by it.

The department described it as the first of a series of antitrust actions designed to break up what is declared to be illegal control by certain oil companies over service stations whereby competition is restrained in petroleum retailing, and other producers of oil and accessories are denied access to retail outlets. The suit charges that exclusive dealer contracts violate Section 1 of the Sherman Act and Section 3 of the Clayton Act.

Geographically the suit covers all the territory within the states of California, Oregon, Washington, Arizona, Nevada, New Mexico, Idaho and Utah. Within this area, it is stated, Standard owns or leases 4,668 service stations, generally on the most important highway intersections and best business sites. Of this number, approximately 1,112 are directly operated as company stations and 2,556 are leased to independent operators on condition that they deal exclusively in products manufactured or sponsored by California Standard. In addition it is charged that California Standard has entered into exclusive-dealing contractural arrangements with 3,332 other service stations and garages so that it controls the products sold through approximately 8,000 retail outlets in its territory.

History of Practice

Tracing the history of this practice, the complaint states that prior to 1926 California Standard acquired title to many of the most desirable filling-station sites. About 1926 it began obtaining leases on such properties which were then subleased to independent operators licensed to deal in Standard products exclusively, under what was termed the "lease and license system."

THE COMPANY'S POSITION

Commenting on the filing of the antitrust suit in Los Angeles against his company, R. G. Follis, president of Standard Oil Co. of California, said the dealer agreements used by the company were of a type common in all business for years. His statement follows:

"We have not as yet seen a copy of the complaint brought by the Department of Justice, but we are assured by our attorneys that Standard of California is not in violation of the Sherman or Clayton Act, as mentioned in press dispatches.

"We have many dealer agreements of a type which has been common in all business for years and which we believe to be perfectly legal in every way.

"Therefore we are astounded that charges as described in press accounts should be brought against this company."

Company officials indicated an additional statement may be forthcoming later after charges have been studied in detail.

Beginning about 1931, California Standard is said to have adopted the "lease and agency" system, whereby operators were constituted as agents for the exclusive distribution of Standard of California products. About 1936 the company is said to have adopted the "Iowa plan" of acquiring and operating retail outlets as a means "to eliminate expenses incident to chain store tax laws, social-security laws, and increasing unionization trends by expressly avoiding an agency relationship with its operators." Under the "Iowa plan," the department says, operators were constituted ostensibly as independent entrepreneurs and given leases conditioned on their exclusive handling of California Standard's petroleum products and sponsored products.

By "sponsored products" the complaint means petroleum products and automotive accessories not produced by Standard of California but contracted and arranged for sale by the company for distribution through its retail outlets. It includes lubricating oil, antifreeze, waxes and polishes, tires, batteries, tire chains, spark plugs, fan belts, oil-filter cartridges, auto-lamp bulbs, and similar articles commonly sold in filling stations and garages.

The Department of Justice charges that the retail outlets controlled by Standard of California through its various types of operation constitute a substantial portion of all favorably situated retail outlets in the western area with the result that manufacturers of competitive nonsponsored products are deprived of the patronage of a substantial portion of the service stations and garages in the area, and that motorists who prefer California Standard's gasoline are deprived of the opportunity to purchase other brands of accessories. This situation is alleged to have restrained interstate commerce and to have substantially lessened competition.

Details of Complaint

The complaint goes into some detail in describing the various "Dealer agreements," "Dealer Agreement T.B.A.," "Distributor Agreements," "Petroleum Products and Equipment Agreements," "subleases," and "oral agreements" which are said to be the illegal contracts by which Standard of California obtained exclusive control of the products sold by the various types of retail outlets.

The two defendant companies are alleged to have influenced independent service-station and garage operators to enter these agreements by various means, including lending money at low or no interest, giving money or forgiving portions of loans, buying old equipment at high prices, selling new equipment at less than cost, and furnishing equipment without charge.

The effect and intention of these practices, the complaint charges, has been eliminating competition between Standard of California and other refiners for the patronage of a substantial portion of the retail outlets in the western area; eliminating competition between manufacturers of California Standard-sponsored products and other manufacturers of similar articles; depriving a substantial portion of the retail distributors of the opportunity of purchasing oil and accessories of their own selection; depriving retailers of the opportunity of purchasing at prices determined by free and open competition; and securing to Standard of California a monopoly of the petroleum-products and automotive-accessory patronage of a substantial portion of the retail outlets in the western states.

The first 26 paragraphs of the text of the Department of Justice's complaint against Standard of California and its subsidiary, Standard Stations, Inc., state the jurisdiction and venue in the case, define the terms used, outline the scope of the companies' operation, and trace the history of

the various types of contracts used by California Standard in its retail-marketing operations. The remainder of the complaint follows:

OFFENSES CHARGED

27. Defendants Standard and Standard Stations, Inc., continuously, for at least 15 years prior to the date of the filing of this complaint, have violated and are now violating Section 1 of the Act of Congress of July 2, 1890, as amended, 26 Stat. 209, 15 U.S.C. 1, commonly known as the Sherman Act, and Section 3 of the Act of Congress of Oct. 15, 1914, as amended, 38 Stat. 731, 15 U.S.C. 14, commonly known as the Clayton Act, in that they have executed and entered into certain written exclusive-supply contracts entitled "Dealer Agreements," "Dealer Agreements TBA," "Petroleum Products and Equipment Agreements," "Distributor Agreements," and "Subleases," and into oral exclusive-supply agreements, by and between themselves and approximately 6,900 independent service station operators and numerous additional garage operators in the western area, which said written contracts and oral agreements are in unreasonable restraint of, and substantially lessen competition in, the herein described interstate trade and commerce in petroleum products and automotive accessories. The said written contracts and oral agreements will continue in effect unless the relief hereinafter prayed for is granted.

28. The said "Dealer Agreements," which are now in full force and effect, provide that the operators party thereto shall purchase exclusively from defendant Standard all of their respective requirements of petroleum products used and sold and bought to be used and sold on the premises described in such agreements. Such agreements further provide, among other things, that the petroleum products referred to therein shall be those brands of gasoline, lubricating oils, and other petroleum products currently sold at service stations operated by defendants in the vicinity of operator's station. Operator further agrees not to store, handle, distribute, or sell any other brand or brands of petroleum products at or from his said station.

29. The said "Dealer Agreement TBA" and the said "Distributor Agreements," which are now in full force and effect, provide, among other things, that the operators party thereto shall purchase exclusively from defendant Standard or Standard Stations, Inc., all of the said operators' respective requirements of petroleum products, tires, tubes, batteries and other lines of automotive accessories distributed by or through defendants Standard and Standard Stations, Inc., used and sold, or bought to be used and sold by the said operators on the premises described in such agreements.

30. The said "Petroleum Products and Equipment Agreements," which are now in full force and effect, provide that the operators party thereto shall purchase exclusively from defendant Standard or Standard Stations, Inc., all of their respective requirements of petroleum products used and sold, and bought to be used and sold on the premises described in such agreements. The said contracts further provide that in consideration therefor, defendant Standard or Standard Stations, Inc., shall, without charge, install and retain title to certain specified equipment and facilities to be used on the premises occupied by the said operators. Some of the said contracts further provide that, upon expiration, said defendants shall tender bills of sale for the said installed equipment and facilities to the operators party thereto, if the said operators have complied with all of the terms of the said contracts and have not terminated such contracts prior thereto.

31. The said "subleases," which are now in full force and effect, provide that the operators party thereto shall lease certain premises from defendants Standard and Standard Stations, Inc., and on such leased premises the said operators shall deal in and sell only such petroleum products as have been purchased from defendant Standard or Standard Stations, Inc. Some of the said subleases provide that the operators party thereto shall have the right to occupy the premises leased only for the sale and distribution of such petroleum products and other merchandise as shall have been purchased from said defendants and that the said operators shall not store, handle, sell, or distribute any petroleum products or merchandise of any description other than that sold or distributed by said defendants.

32. The said oral agreements entered into by and between defendants Standard and Standard Stations, Inc., and the said independent service-station operators and garage operators have consisted and now consist in agreements that said defendants shall sell and fix prices, discounts, and rebates on sales of petroleum products and automotive accessories on the condition, agreement, and understanding that the said operators who purchase such products shall agree to use, handle, and resell only those petroleum products and automotive accessories sold or sponsored by defendant Standard.

33. Defendants Standard and Standard Stations, Inc., have persuaded, induced and influenced the said independent service-station operators and garage operators to enter into the aforesaid written contracts and oral agreements by divers means and methods, including among others, the following:

(a) By lending money to the said independent service-station operators and garage operators at rates of interest below current rates and without interest charges.

(b) By giving money to and by forgiving portions of loans receivable from the said independent service-station operators and garage operators;

(c) By buying equipment from the said independent service-station operators and garage operators and reselling the same said equipment to the same said parties at prices less than the purchase prices;

(d) By selling new equipment to the said independent service-station operators and garage operators at prices below cost to defendant Standard;

(e) By furnishing new equipment to independent service-station operators and garage operators without charge, all on the condition that the said independent service-station operators and garage operators shall agree to deal exclusively in petroleum products sold by defendant Standard and, in many instances, exclusively in automotive accessories sponsored or distributed by defendants Standard and Standard Stations, Inc.

EFFECTS OF THE CONTRACTS

34. The aforesaid contracts have had the effects, as intended by defendants Standard and Standard Stations, Inc., of

(a) Eliminating competition between defendants Standard and Standard Stations, Inc., and other producers and manufacturers of petroleum products of like utility and quality for the patronage of a substantial portion of the retail outlets for such products in the western area.

(b) Eliminating competition between manufacturers and producers of defendants Standard's and Standard Stations, Inc.'s sponsored products and other manufacturers and producers of products of like utility and quality for the patronage of a substantial portion of the retail outlets for such products in the western area.

(c) Depriving a substantial portion of the retail outlets for petroleum products and automotive accessories within the western area of the opportunity of purchasing such products from producers and manufacturers of their own selection.

(d) Depriving a substantial portion of the retail outlets for petroleum products and automotive accessories within the western area of the opportunity of purchasing petroleum products and automotive accessories at prices determined by free and open competition among the producers and manufacturers of such products.

(e) Securing to defendants Standard and Standard Stations, Inc., a monopoly of the petroleum-products and automotive-accessories patronage of a substantial portion of the retail outlets for such products within the western area, and have had the effect thereby of restraining and substantially lessening competition in the interstate trade and commerce in petroleum products and automotive accessories hereinabove described.

PRAYER

Wherefore, the plaintiff prays:

1. That the court adjudge and decree that defendants Standard and Standard Stations, Inc., have entered into contracts which unreasonably restrain interstate trade and commerce in petroleum products and automotive accessories, in violation of Section 1 of the Sherman Act.

2. That the court adjudge and decree that defendants Standard and Standard Stations, Inc., have substantially lessened and restrained competition in petroleum products and automotive accessories, in violation of Section 3 of the Clayton Act.

3. That the exclusive-supply provisions in the written contracts and oral agreements between defendants Standard and Standard Stations, Inc., and independent service-station operators and garage operators, more particularly described hereinabove, be declared void and of no effect, and in unreasonable restraint of and as substantially lessening competition in interstate commerce in petroleum products and automotive accessories and in violation of Section 1 of the Sherman Act and Section 3 of the Clayton Act.

4. That defendants Standard and Standard Stations, Inc., and their officers, directors, agents, representatives, and all persons and corporations acting or claiming to act on their behalf, be perpetually enjoined from entering into or enforcing any contract, agreement, or understanding, express or implied, with any independent service-station operator, or garage operator, or from inducing or compelling, or attempting to induce or compel, by any means whatever, any independent service-station operator, or garage operator, to enter into any contract, agreement, or understanding which provides:

(a) That the independent service-station operator or garage operator shall secure all of his requirements of petroleum products from defendant Standard, or shall not handle the petroleum products of any other company.

(b) That the independent service-station operator or garage operator shall secure all of his requirements of any one or more types of automotive accessories from or through defendants Standard and Standard Stations, Inc., or will not handle accessories competitive with those distributed or sponsored by defendants Standard and Standard Stations, Inc.

(c) That the sale of any petroleum product or automotive accessory to any independent service-station operator or garage operator shall be conditional on the sale of other petroleum products or automotive accessories.

5. That plaintiff have such other and further relief as the nature of the case may require and the court may deem proper in the premises, and that plaintiff recover the costs of this suit.

6. That pursuant to Section 5 of the Sherman Antitrust Act, an order be made and entered herein requiring the defendants named herein to be brought before the court in this proceeding as parties defendant, and directing the marshal of the Southern District of California to serve a summons upon them, and demanding that they appear herein and answer the allegations contained in this complaint and thereafter abide by and perform such orders and decrees as the court may make and enter.

_____this week

REGULATION— U. S. Supreme Court denies review in Interstate Natural Gas Co. case, thus upholding FPC's authority to regulate rates of producing and gathering companies. . . . Decision expected to give weight to drive for congressional action to curb widening powers of federal commission. . . . Ruling reduces company's rates to figure yielding 6.5 per cent on investment. . . . ¶Another Supreme Court order refuses review of order cutting Cities Service Gas rates $25,000,000. . . .

ANTITRUST— Department of Justice files civil antitrust action in federal court in Los Angeles against Standard of California and subsidiary, Standard Stations, Inc. . . . Action aimed at alleged restraint of trade in exclusive-dealer contracts with independent filling stations. . . . R. G. Follis, California Standard president, says agreements involved have been common in all types of business for years and that company is "astounded" at charges. . . . Department says similar suits to be filed elsewhere. . . .

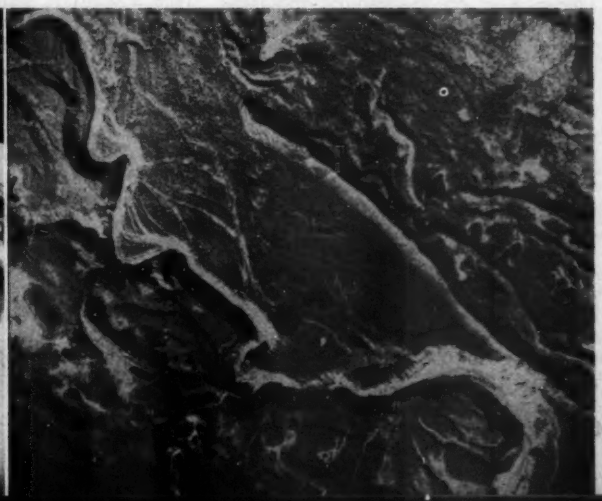
INTERNATIONAL— Cie. Francaise des Petroles, French partner in Iraq Petroleum, indicates possible contest of Jersey Standard-Socony-Vacuum deal to buy into Arabian American on grounds it violates "Red Line Agreement" of 1928. . . . French company says it will protect Middle East interests "by all juridicial means." . . . ¶Iranian Government replies to second note from Russia inquiring about status of last spring's plan to organize joint Russian-Iranian company to develop northern oil concession. . . . Iranian foreign minister reiterates Iranian Parliament must approve deal. . . . ¶Jersey Standard interests organize Esso Development Co., Ltd., to carry on petroleum-research work in Great Britain. . . . ¶Creole's 1946 crude-oil tax bill figured at $32,000,000 in view of permanent progressive surtax passed late in December by Venezuelan Assembly. . . . Total higher than 1945 due to increased production. . . . ¶Iraq Petroleum announces plan to drill another test in Lebanon at Jebel Terbol. . . . ¶Shell affiliate reaches 5,854 ft. in test in Coco Key in Cuba. . . .

ACQUISITIONS— Trinidad Leaseholds, Ltd., buys Goodrich Refinery Co., Toronto, in move to gain market outlets in Western Hemisphere dollar zone. . . . Standard Oil Development buys U. S. owned hydrogenation equipment at Baytown, Tex., for $102,070. . . . ¶Floyd L. Karsten, Houston independent, buys Ohio Oil's holdings in McCoy pool, Liberty County, Texas, for more than $1,000,000 in cash and oil. . . .

REFINING— Little chance seen by refiners of immediate raise in octane ratings despite lifting of government lead controls. . . . Lead supplies expected to continue in short supply. . . . ¶Pure Oil submits only bid of $630,200 for alkylation unit at Smith's Bluff, Tex. . . . ¶Glenn H. McCarthy announces plans to build chemical plant at Winnie, Tex., with first unit costing $3,000,000. . . . ¶Enjay Co., Inc., organized by Jersey Standard to market chemical products of Stanco Distributors, Inc., and Standard Alcohol Co. . . . ¶Petroleum-industry engineers meet with automotive experts to discuss fuel problems as a part of the annual meeting of the S.A.E. in Detroit. . . .

BIG INCH— WAA submits new disposal report to Congress. . . . Pennsylvania congressman representing coal-producing area prepares bill to delay sale until 6 months after FPC reports on its natural-gas investigation. . . . ¶Texas Railroad Commission grants gas-allowable increase of 60,000,000 cu. ft. daily to Lone Star Gas, one of the Big Inch suppliers under the interim lease to Tennessee Gas & Transmission. . . . .

The science of geology and the relatively new development of aerial photography are being combined by oil companies to promote their exploration activities. Known as aero-geology, the combination of sciences is looked upon by geologists as a valuable instrument in the world-wide search for oil. A geologist of Imperial Oil, Ltd., which made the pictures above, pieces together aerial photographs to make a mosaic, from which much of the geological structure of the area can be determined. Use of stereoscopes makes photographs such as the one at right almost exact three-dimensional models of the area being studied



Big Inch Fight Indicated as WAA Submits New Report

WASHINGTON.—The Government's Big Inch pipe-line systems will be sold promptly for the transportation of natural gas and at a good price, in the opinion of Robert M. Littlejohn, war assets administrator.

This was disclosed in his supplemental report to Congress submitted January 3, outlining the conditions for bids which will be opened February 10 unless Congress rejects the report within 30 days.

But at the same time Rep. Francis E. Walter of Pennsylvania introduced a resolution to prohibit WAA from disposing of the pipe lines until 6 months after the Federal Power Commission has filed its report in its current natural-gas investigation. Representative Walter, who comes from an anthracite region, has been one of the leading opponents of the transportation of natural gas to coal-burning areas, and was a witness before the House surplus-property investigating committee in opposition to use of the Big Inch lines for gas.

The supplemental report proposes to sell the lines for the transportation of either petroleum and its products or natural gas, or both, with reservation that oil-pumping facilities be maintained and the entire property be available for recapture by the Government in emergency. This plan, the report says, will protect the national interest and will assure sale at somewhere near the current valuation of the lines. Because of administrative costs, outright sale is preferred to a lease.

Effort at Restriction Made

Correspondence attached to the report as exhibits reveals that Secretary of the Interior J. A. Krug attempted to have WAA restrict the lines to gas use only, and to require a certain amount of flare gas to be transported, on the ground that this would provide the maximum contribution to conservation of natural resources.

"It is my firm opinion," Krug wrote on December 12, "that these considerations affecting the national interest should not be dismissed and the highest bid made the sole standard of disposal."

Littlejohn rejected this on the ground that it would open up a new controversy over disposal of the lines and would make the bids too complicated to analyze, but he did insert in the bid form a request that bidders proposing to use the lines for gas submit a statement of a plan to utilize flare gas and indicated the estimated amount to be transported. On December 18 he wrote Krug:

"I, as a salesman, am primarily concerned in disposing of these lines at the earliest practicable date and securing for the Government the maximum net return in cash dollars."

He added that for purposes of information he would ask each bidder to submit a plan for utilization of flare gas, but "any action beyond this is one for the Congress to decide."

The standard form on which all new bids must be submitted sets forth all the terms of sale, so that bids will be identical from this standpoint.

The bid form states that the lines are being sold "as is, where is" and that the Government will transfer only those rights and easements which it now has, except that the Government will complete legal actions now pending to acquire titles and easements. The attention of bidders is called to restrictions ostensibly imposed by the states of Louisiana and Pennsylvania on use of the lines for natural gas, and a purchaser who proposes to use the lines for gas is required to file an application for a certificate with the Federal Power Commission within 30 days of the award.

A detailed set of national security provisions is attached to the bid form, providing that the Government reserves a "dormant estate" in the property for a period of 20 years, to be administered by the Secretary of War. This gives the War Department the right to inspect facilities kept standby for oil transportation, and prohibits the purchaser from altering any of these facilities without approval of the secretary. Also the War Department may take over the lines if the operator fails to maintain these facilities properly.

Industry's Total 1946 Production Valued at $2,440,000,000

WASHINGTON.—Total value of the petroleum industry's record-breaking 1946 production of crude oil was placed at $2,440,000,000 in a Bureau of Mines review of mineral and mineral-fuel output in the year just ended.

The value of the 1946 crude production was on the basis of an estimated output of 1,731,000,000 bbl.—1.2 per cent greater than in 1945. Included in the total value were subsidies paid under the stripper-well program.

The bureau reported that the total value of mineral and mineral products in the United States and Alaska in 1946 reached an all-time peak of $8,900,000,000, exceeding 1944 by 6 per cent and some 9 per cent over the 1945 valuation. Establishment of the new record, the bureau pointed out, resulted largely from the general advance in price of mineral commodities in 1946.

Total value of all mineral fuels, principally coal and petroleum, was $5,700,000,000 compared with $5,212,000,000 in 1945. While strikes cut production of bituminous coal and lignite to 528,000,000 net tons, down 8.6 per cent from 1945, new production records were established in all branches of the petroleum and natural-gas industries, the bureau said.

The total value of the petroleum industry's 1946 production represents an increase in the average value at the well from $1.22 per barrel in 1945 to $1.41 in 1946.

Total demand for all oils in 1946 is estimated at about 1,927,000,000 bbl. compared with 1,952,000,000 in 1945—a decline of about 1.3 per cent. All of this decline was in exports, and domestic demand may have exceeded that in 1945. The most notable factor in domestic demand was the large civilian consumption of motor fuel, particularly for automotive use, the report noted.

Stocks of all oils probably increased about 55,000,000 bbl. during 1946, it said. Part of this increase was a normal replacement of depleted stocks, but the total increase indicates that primary production and imports materially exceeded requirements.

The marketed production of natural gas increased to about 4,040,000,000,000 cu. ft. in 1946, a gain of 4 per cent over 1945 characterized by continued increases in domestic and commercial consumption. The total value at points of consumption was about $835,000,000 in 1946.

Natural-gasoline and cycle plants extracted 4,836,000,000 gal. of liquid products from natural gas in 1946, 3 per cent more than in 1945. The value of all products at the plants amounted to about $186,000,000 in 1946, slightly below the 1945 total owing to lower prices received until the late months of 1946.

DIGESTS

A. A. P. G. MEETING, WICHITA

GEOLOGICAL findings in many actual and potential oil-producing areas of Mid-Continent, Rocky Mountain, and Southwest sections will be exchanged at a regional meeting of the American Association of Petroleum Geologists January 16-17 in Wichita.

The meeting will be held under the sponsorship of the Kansas Geological Society. These digests are abridgements of papers to be presented at the meeting.

Geophysics in the Mid-Continent—Past Results and Future Application

G. H. WESTBY, President, Seismograph Service Corp., Tulsa.

ONLY three geophysical methods, magnetic, gravitational, and seismic, have obtained results of recognized geologic value in the Mid-Continent area.

In areas of shallow basement rocks the magnetic method has provided reasonably good general structural information, such as the tracing of the Amarillo ridge, the tracing of the Arbuckle Mountains to the southeast, the establishment of structural graining in Kansas, and (in a few isolated instances) the location of certain structures of average oil-field size.

The gravitational method in the Mid-Continent was applied first with the torsion balance and later with the gravity meter. Certain large structural trends were indicated, such as the southeastward extension of the Wichita Mountain axis into Texas, regional trends in Kansas, regional trends in Nebraska and the Dakotas, and certain large individual structures, such as Healdton field and Oklahoma City field. Quantitative-interpretation studies indicate most Mid-Continent structures are not of suitable size or type to produce recognizable gravity anomaly. Density changes in the basement rocks cause most of the anomalies and cannot usually be satisfactorily eliminated. Ancient lines of weakness in the basement rocks revealed by gravitational methods may control the general location of structures in the sedimentary rocks.

Seismic reflection work commenced in the Mid-Continent in 1927 with the correlation method, which, though successful in discovering larger fields, such as Lucien, was gradually replaced by the more detailed continuous profile method to locate structures of greater complexity. Correlation programs in areas of low-dip, simple structures, and good reflectors were successful, such as those in western Kansas on the Cimarron anhydrite, and in Colorado and Nebraska on limestones in the Cretaceous and on the Cimarron anhydrite. Present application in Oklahoma utilizes continuous profile, three-dimensional shooting to map complex structures and determine stratigraphic information for the location of pinch-out production.

Refraction seismic method is being and will be utilized in the Texas Panhandle, certain areas of the Anadarko basin in which reflection work is unsatisfactory, and areas of southern Kansas to reveal large structures. Satisfactory structural information is being obtained from many areas for the first time by the refraction method.

The magnetic method will be of little value for future prospecting in Oklahoma and Kansas. Gravitational methods may be utilized in the Anadarko basin to determine general trends. In Nebraska, in the Williston basin, and in the less well-known areas of Montana and Wyoming, both magnetometer and gravity-meter surveys should be made to determine structural graining and to localize areas for seismic exploration. It is to be noted, however, that these methods provide only a starting point for seismic exploration and that suitable structures may be present and unrevealed by either the magnetic or gravitational method. Application of detailed reflection seismic methods to the Anadarko basin area to map complex structures and localize areas of stratigraphic-trap accumulations, such as the West Edmond type or Garvin County Pennsylvania type, alone should provide enormous additional reserves. Refraction seismic methods will localize deep structures in hitherto unworkable areas of the Anadarko basin. Northern Mid-Continent will continue to be explored by normal application of the three methods in usual order, magnetic, gravitational, and seismic.

Norman Wells Oilfield

J. S. STEWART, Geological Survey of Canada.

THE Norman Wells oil field is located on Mackenzie River in the Northwest Territories of Canada, about 90 miles south of the Arctic Circle. The oil reservoir is a reef limestone in shales of Upper Devonian age. The structure is monoclinal, and the strata dip about 5° toward the southwest. Closure on the updip side is caused by a pinching out of the reef. The top of the reservoir is at depths of 1,050 to 1,950 ft., depending on position on structure. The field has 60 productive wells, and these outline an area of 4,010 acres that will probably prove productive. Estimated recoverable oil reserves are 36,250,000 bbl. from a drainable area of 2,600 acres. The other 1,410 acres of potentially productive territory are covered by the river and are not considered drainable at present.

The wells produce by natural flow, and under rigid control the field produced at the rate of over 4,300 bbl. per day in October 1944. The original reservoir pressure was 695 psi. at 1,000 ft. subsea which is abnormally high for wells having an elevation of around 300 ft. The oil has a gravity of 39° to 41°. On January 1, 1946, the field had produced a total of 2,050,528 bbl.

Marine Pool, Madison County, Illinois

HEINZ A. LOWENSTAM, Illinois State Geological Survey, Urbana, Ill.

THE Marine pool, discovered in 1943, in the eastern half of Madison County, is near the western border of the Eastern Interior basin on the gently sloping shelf between the Ozark uplift and the Illinois basin.

This is the first known occurrence of oil production from a Silurian reef in Illinois. The principle producing zone in the Silurian is a coquina-like, detrital limestone which forms the mantling deposit of a post-Alexandrian reef.

The reef topography is that of a dome deeply grooved along its northern flank and thus resembles a horseshoe in outline. A subsidiary northeast-southwest-trending structure southeast of the main reef and connected with it by a low saddle is interpreted as a forereef. There is about 100 ft. of closure over the reef area.

The reef topography is reflected in the post-Silurian strata but becomes less pronounced in the higher beds. The Trenton conforms to or is structurally lower than the regional dip in the two deep tests that were drilled through the flanks of the Silurian reef. The Marine pool structure is therefore interpreted as due only to the local increase in thickness and to the rigid unyielding dolomite frame of the post-Alexandrian reef deposits in the surrounding compactable silty and argillaceous normal interreef strata.

As many as four porous discontinuous streaks have been reported from the principal producing zone of the Silurian reef-capping limestone. The observation of secondary porosity zones in the wall-rock adjacent to tightly sand-and-clay-sealed, solution-enlarged cavities and fissues indicate a porosity network which may connect the discontinuous streaks and extend into the underlying reef core.

The solution-enlarged fissures which are sealed by clay and sand extend in great numbers from the post-Wapsipinicon unconformity of Middle Devonian age, downward into the Silurian deposits. It is assumed that the Devonian production of a few wells over the southern margins of the Silurian reef is fissure production of Silurian oil.

Unusual Oil Fields in the Rocky Mountain Region

C. E. DOBBIN, Denver, Colo.

AS compared with oil and gas accumulation elsewhere, accumulation in the Rocky Mountain region is unusual for (1) oil ranging from 11° to 76° gravity (A.P.I.) has been produced from strata ranging in age from lower Mississippian to Oligocene; in fact, strong showings of oil have been found in all pre-Mississippian series present; (2) strata in several series often yield different kinds of oil in one field; (3) oil from pre-Jurassic strata tends to be heavy, sour, and black, and that from younger strata tends to be light, sweet, and green, which is contrary to the general law of evolutionary transformation of oil with depth and age; and (4) some of the gases are rich in helium and carbon dioxide.

Circulating ground water has played the major role in accumulation, or lack of it, and the character of the oil probably depends largely on the chemical conditions encountered in reservoirs and during migration to them.

Kraft-Prusa Field, Central Kansas

ROBERT F. WALTERS, Gulf Oil Corp., Tulsa; and ARTHUR S. PRICE, Gulf Oil Corp., Chase, Kans.

THE Kraft-Prusa field in northeastern Barton County is unusual because the drilling of 664 tests to December 14, 1946, has resulted in 507 oil wells and 157 dry holes, or a ratio of one dry hole for every three oil wells.

The oil reservoirs may be grouped into four types: (1) Reservoirs in the Cambro-Ordovician Arbuckle dolomite at its unconformable contact with Pennsylvanian beds at an average depth of 3,350 ft. Porosity is due to solution. The 405 wells do not flow. Reservoir energy is derived largely from bottom-water drive. (2) Reservoirs in the Pennsylvanian limestones, producing in 51 wells. The best porosity is in 3 to 10-ft. beds

(Continued on page 119)

International

WORLD-WIDE OIL DEVELOPMENTS

Completion of Bahrein Asphalt Plant Is Due This Fall

NEW YORK.—By next September or October, Bahrein Petroleum Co., Ltd., expects to complete its $2,100,000 modern asphalt plant as an addition to the company's Bahrein Island, Persian Gulf, refinery. This refinery is now turning out approximately 115,000 bbl. daily of products.

Designed to have an initial annual capacity of 50,000 long tons (about 385,000 bbl.) of asphalt, the plant will be so laid out as to triple this yearly output with a minimum of additional equipment. Present plans are to market the asphalt in drums throughout the Near and Far East marketing areas. However, with European markets, which Standard Oil Co. of California will acquire through a joint interest with The Texas Co., it is entirely possible that some asphalt will also be destined for other areas.

The new equipment to be installed consists of a vacuum still charging topped crude, with a daily charging capacity of 10,000 to 12,000 bbl. The reduced stock from the vacuum unit will be charged to converters and reduced to the proper grade of paving or specialty asphalt by the use of low-pressure air.

Originally it had been hoped that the asphalt plant would be completed by July, but inability to obtain the necessary materials has retarded construction. In late February or early March technical construction crews from the United States are expected to be on hand.

R. M. Brown, general manager of Bahrein Petroleum, will be in charge. International Bechtel Brothers and McCone, Inc., is the contractor.

Bahrein Petroleum is jointly owned by Standard Oil Co. of California and The Texas Co. California Standard has announced plans whereby it will acquire a 50 per cent interest in Texaco's extensive European and African marketing facilities. California Texas Oil Co., Ltd., the marketing arm of Bahrein Petroleum, or another subsidiary, is slated to handle the increased operations. Products from Arabian American Oil Co.'s Ras Tanura refinery probably will also be handled by the California Texas marketing affiliate.

Creole's Crude-Oil Tax Bill Placed at $32,000,000

NEW YORK.—Last year's Venezuelan crude-oil taxes for Creole Petroleum Corp., the largest oil producer in Venezuela and in the world, reportedly will total approximately $32,000,000.

This is figured on the basis of the 28 per cent progressive surtax passed December 28 by Venezuela's Constituent Assembly and deducting the 4 per cent allowed for a certain amount of capital that was reinvested.

Last year, Creole paid taxes amounting to $28,952,323 of which $18,679,000 was due to the December 31, 1945, extraordinary-tax decree. While the 1946 surtax is actually lower, the estimated $32,000,000 figure is due to Creole's increased production last year.

Venezuela's second largest crude-oil producer is the Royal Dutch-Shell group of companies (Colon Development Co., Ltd., Caribbean Petroleum Co., and Venezuelan Oil Concessions, Ltd.) which, in 1946, had a combined daily average production of 300,000 bbl. against Creole's 1946 average of 550,000 bbl. Shell's taxes may be in the neighborhood of $25,000,000. Both Shell and Creole have reinvested large sums of money in Venezuela during the past year and thus will benefit from the 4 per cent provision.

Cie Francaise Critical of Arabian American Deal

NEW YORK. — Cie Francaise des Petroles, a partner in Iraq Petroleum Co., Ltd., is preparing to protect its Middle East interests by all juridical means, the New York Times says in a dispatch from Paris.

The statement of the French company referred to the recently announced negotiations under which Standard Oil Co. (N. J.) and Socony-Vacuum Oil Co., Inc., also partners in Iraq Petroleum, are to acquire a substantial interest in the Saudi Arabian properties of Arabian American Oil Co.

Under the Red Line Agreement of 1928, partners in Iraq Petroleum agreed not to conduct oil operations within a certain Middle East area, including Saudi Arabia, except for joint account. The two American companies buying into Arabian American reportedly consider the agreement dead because of the wartime status of Cie Francaise as an enemy alien.

The Times dispatch said the French company considers it was not kept informed of the recent Middle East negotiations, though these negotiations were not mentioned by name. The French company was quoted as stating the two American companies "have not respected the 1928 accord."

Labor Committee to Meet

LOS ANGELES.—First meeting of the industrial committee for the petroleum industry of the International Labor Organization will be held here February 3. The committee is composed of representatives of 12 countries, with each delegation including two government members and two representatives from both labor and management.

Creole's October Output Down 10,333 Bbl. Daily

NEW YORK.—Venezuelan crude-oil production of Creole Petroleum Corp. averaged 575,351 bbl. daily during November, a drop of 10,333 bbl. as compared with October when the daily average was 585,684 bbl. November's daily refinery throughput averaged 73,651 bbl., or an increase of 18,590 bbl. over October's average daily throughput of 55,061 bbl.

November's 575,351 bbl. daily output figure shows that this is the first time since last June that Creole's daily average production has been less than 580,000 bbl. daily.

In November, 421,897 bbl. daily came from Lake Maracaibo area and Cumarebo, with the remaining 153,454 bbl. daily coming from eastern Venezuela. The daily refinery throughput showed that 64,226 bbl. daily were processed at the Caripito refinery and 9,425 bbl. daily at the La Salina plant.

Twenty oil wells were brought in during November, including one wildcat in the Jusepin area and one well (B-4) omitted in the October report. No gas wells were completed but there were four dry holes. The Jusepin area wildcat went down to a depth of 4,767 ft. No production test figure was shown.

The fields where these wells came in, their average initial production, and depths follow:

Jusepin seven, 471 bbl., 4,372 ft.; Bolivar Coastal (B.C.F.) six (including well B-4 omitted in the October report), 1,313 bbl., 3,659 ft.; Mulata three, 876 bbl., 5,579 ft.; Cumarebo one, 460 bbl., 1,811 ft.; Quiriquire one, 735 bbl., 4,996 ft., and San Joaquin one, 754 bbl., 5,356 ft.

In West Lake field Creole reported completion of a dry hole, (VL-1), drilled for Shell, at 8,557 ft. An exploratory well in the Guarico area was abandoned at 6,319 ft.

Research Organization Formed In Great Britain

LONDON.—Esso Development Co., Ltd., a petroleum-research development organization, has been formed in Great Britain by Standard Oil Co. (N.J.). Shareholders in the new firm are Anglo-American Oil Co., Ltd., and Standard Oil Development Co., both affiliated with Jersey Standard.

Standard officials said the new organization will work closely with consumers, the government, and scientific bodies of British universities. Its work also will be coordinated with Standard group research organizations in the United States and Canada.

Iraq Petroleum Co. Will Drill Test in Lebanon

BEYROUTH.—Another attempt to find oil in Lebanon will be made this spring by Iraq Petroleum Co., Ltd. Company officials announced the firm will begin drilling in March at Jebel Terbol.

The company and its affiliates previously have conducted drilling operations in the area without success. In mid-December I.P.C. announced plans for a $70,000,000 expansion program, including exploratory drilling and enlargement of its Kirkuk-Mediterranean pipe line.

End of Military Sales Threatens Shortages

Decision of the United States military officials to end the sale of petroleum products to civilian companies forced several domestic airlines in the Philippines to suspend service temporarily and threatened the use of a quota system for importation of petroleum products in China.

In Manila J. Parish, general manager for Standard-Vacuum Oil Co., said adequate supplies are available but distribution systems have not been restored yet in some areas where airlines have been refueling from Army facilities. In Nanking, government circles said extremely short stocks of imported products has caused the Supreme Economic Council to take up a study of a quota system of imports, accompanied by a rationing of gasoline and oil to consumers.

International

Indonesian Republic Asks Change in Oil Contracts

The Indonesian Republic will recognize prewar contracts for exploration of oil concessions in Indonesia provided the Indonesian Republic replaces the Netherlands East Indies Government as the party to the contracts, according to Economics Minister Mani, of the republican government. Arrangements will be made immediately, he said, for key foreign personnel to inspect oil fields in the interior of Java and Sumatra.

Cuban Test Down 5,854 Ft.

NEW YORK.—Cia. Petrolera la Estrella de Cuba (Shell group) is down to 5,854 ft. on its second test on Coco Key. The first shallow test proved to be a dry hole. The second test, started last summer, is being drilled by Loffland Bros. Co.

Restoration of War-Drained Reserves Occupies Trinidad Leaseholds

HEAVY wartime withdrawals from fields on the Island of Trinidad, British West Indies colony, have made the discovery of new reserves the principal postwar objective of the island's major producer, Trinidad Leaseholds, Ltd.

This problem is emphasized throughout the company's recent annual statement, the first made public since the war. "The need for discovery of new oil resources, to check the decline in our proven and probable reserves, is of primary importance," Brig. R. S. G. Stokes, chairman of the board, told stockholders. "Results of recent exploration have been disappointing. Extensive territory remains for exploration, by geophysical survey and drilling, upon our own properties and upon those held jointly with other interests in land or marine areas."

Trinidad Leaseholds, Ltd., is the only fully integrated oil company operating in the British colonial empire. During the year ended June 30, 1946, the period covered by the statement, it produced 6,419,800 bbl. bought and produced from joint fields an additional 6,012,800 bbl., and refined a total of 12,362,000 bbl.—almost 60 per cent of the colony's total output.

While highlighting the need for large-scale exploration work, the statement discussed all phases of its activity and future prospects. It indicated modernization of the 50,000-bbl. daily refinery at Point-a-Pierre may be undertaken later and, in the marketing field, called attention to the possibility that "cheaply won" Middle East oil may become a dangerous competitor of that produced in the Caribbean.

In carrying out its exploration program, the company is conducting both exploratory drilling and geophysical surveys. Seismic work is proceeding in the southern area of the Barrackpore field and will be extended later to other areas, the statement said.

In discussing Barrackpore, the com-

pany report said further drilling has been undertaken to test the Herrera sands which lie at a horizon below the main producing strata. Results were encouraging in one well, but it now appears that the sand is of an irregular character both in location and production possibilities. This work is being continued.

Two other areas in which accelerated exploratory drilling was carried out during the war are Guayaguayare field (north) and Guayaguayare field (south). In the former, the statement said, work is difficult and expensive but the possibilities of the whole region should be tested exhaustively. As for the south field, further drilling was said to be no longer justified since two wells were abandoned after failing to produce commercially.

Underwater areas also are receiving attention in exploration efforts, the company reported. Trinidad Leaseholds, Ltd., is interested in several other companies, and one of these, Trinidad, Northern Areas, Ltd., is preparing for a resumption of field activities this year. Marine areas allocated to this company through the partnership agreement amount to 95,000 acres in the 3-mile limit and 85,000 acres of other marine territory off the southwest coast of Trinidad.

Trinidad Northern Areas, Ltd., is planning to begin drilling this year off Point Fortin to test the extension of an existing field on land. It also has acquired further leases on land and has been granted an exploration license covering 19,500 acres in the Central Range.

North Venezuelan Petroleum Co., Ltd., in which Trinidad Leaseholds, Ltd., also is interested, has recently concluded an agreement with Creole Petroleum Corp. for the joint exploration of the North Venezuelan Petroleum's large concession. This agreement providing for the drilling of several wells "overcomes the company's immediate difficulty of obtaining sufficient foreign currency to enable it to undertake an active program on its own account."

Trinidad Leaseholds holds interest in British Bahamian Oil Development, Ltd., engaged in exploration in the Bahamas, but, the Trinidad Leaseholds statement continues, "results of work to date are too limited to warrant the expression of any conclusions as to the commercial possibilities of the region."

Trinidad Leasehold's production, for the year covered by the report, of 6,419,800 bbl. represented a decrease of 762,100 bbl., or some 11 per cent. This, the company reported, was the result of a reduction in output of the Forest Reserve field below the "unduly high" level prevailing during the latter part of the war. The 6,012,800 bbl. of crude purchased and produced from jointly held fields compares to 7,838,500 for the preceding 12-month period, with the reduction being primarily due to the cessation of imports of Venezuelan crude for war purposes and to a decrease in production by other Trinidad operators. Material shortages were responsible for a reduction in footage drilled in the company's fields to 152,617 ft. from 160,094 ft. in 1944-45.

"Unit costs for production and drilling continue to rise, largely due to the incidence of higher wages, material costs, and other charges," the board chairman said. "The gradual increase in the proportion of oil produced by artificial lift is another factor putting up our working expenditure. Good field practice has suffered seriously owing to the shortage of electric well-pumping equipment, which we are pressing manufacturers in the United Kingdom to deliver more speedily."

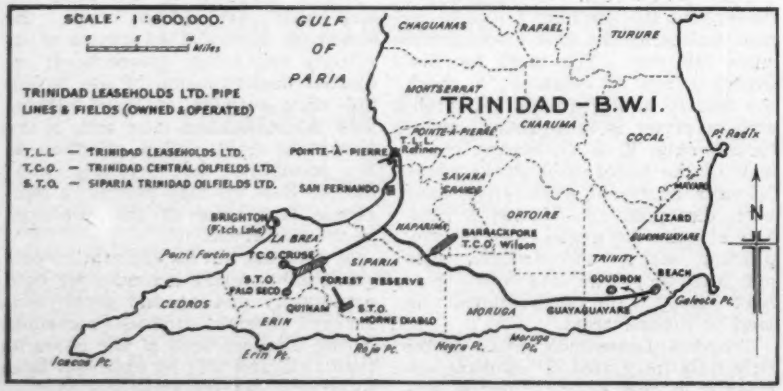
In the refining field, Trinidad Leaseholds reported the surplus refining capacity resulting from decreased demand for war products, had been utilized through a processing agreement with an unnamed American company. By the arrangement, unit costs are reduced, and trained men are retained in effective employment. The aviation-gasoline refinery operated by the company during the war and subsequently acquired from the British Government, has been utilized "on a limited scale pending adaptation to commercial requirements within the framework of the company's general postwar plans."

Another refinery acquisition of Trinidad Leaseholds was a plant near Toronto, Canada. The purchase of this firm included terminal and storage equipment and distribution facilities within a radius of about 200 miles. *(For further information on this purchase, see the Refining News Section, page 94).* "Your directors," Stokes said, "have explored the possibility of entering new markets beyond the United Kingdom and the Caribbean Islands and preferably in the dollar zone. The natural outlet for Trinidad oil products lies geographically in the Americas, and we have long recognized that the Dominion of Canada, with its bright prospects of expansion and prosperity, offers the highest chances of reward."

Postwar Marketing Changes

Commenting on postwar changes in marketing in the United Kingdom, the statement said the company faced the future prospect of supplying a full range of products throughout the kingdom. "These demands . . . impose unusual difficulties upon a company of our capacity with a limited quality-range of crude oils for processing," the report continued. "Another serious factor, to which attention has already been drawn by other oil interests, is the prospect that in the European markets cheaply won oil from the prolific resources of the Middle East will become a dangerous competitor of Caribbean oil."

The statement pointed out operations in Trinidad and Venezuela are markedly different. "In Venezuela, with its vast rich fields extending along a belt of some 700 miles from East to West, the maximum recovery of oil from areas of marginal payability has not yet become an industrial demand of acute national importance," it said. "In Trinidad, the picture is a very different one. Fields are smaller and subject to higher costs of production. Reservoirs are small and irregular. Close spacing of wells is necessitated by unfavorable sand conditions. Prospects of finding big new reservoirs that could be cheaply worked are comparatively poor, and while the search for oil is becoming more expensive, the prospective reward for taking risks grows less. Decline of profits upon existing fields, from whatever cause, will reduce our financial capacity to adopt all measures most desirable for the attainment of maximum recovery . . ."



Southern Trinidad showing Trinidad Leaseholds, Ltd., operations

Co-op Moves in International Field Stir Interest of Industry

by Warren W. Burns

NEW YORK.—With the frequently repeated and always puzzling theme that "oil should be equally accessible to all nations"—the inference being that this is not the case—interest is slowly mounting in foreign and domestic oil circles here as the recently organized International Cooperative Petroleum Association, in their own words, "launch their greatest challenge to international trusts and combines."

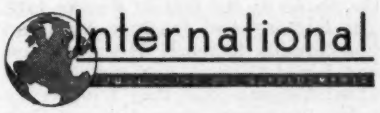
This, by itself, might be interpreted as a mere dream were it not for the fact that the I.C.P.A. is already well organized and in fact now enjoys consultative status, as a nongovernmental agency, to the United Nations Economic and Social Council. Moreover, the I.C.P.A., along with the World Federation of Trade Unions and a few other nongovernmental agencies, now has the right to propose questions for the council's agenda. Politically, at least, this puts the I.C.P.A. in a strong position.

Interest also is wide in relation to the world co-op's formal approval of the use of a foreign language in future sessions. It will be Russian.

At its closing October session in Zurich the International Cooperative Alliance, of which the I.C.P.A. is an affiliate, approved a resolution for control and administration of the world oil under an authority of the United Nations as a first step to "eliminate international rivalry over raw material resources and checkmate monopolistic tendencies," as explained by an official Cooperative News Service release.

At first, attention will be directed at Middle East oil where, the co-ops state, a crisis is arising to poison the Allies' friendly relations. That the most will be made of this assertion is the fact that a more active interest and participation will be taken by the I.C.P.A. in the United Nations, and specifically in the U.N.'s Economic and Social Council. It is here that the I.C.P.A. has an official voice.

At a recent meeting of the U.N. committee on arrangements for consultation with nongovernmental organizations, the question arose as to whether the World Federation of Trade Unions should be the only nongovernmental agency to be granted permission to submit questions for inclusion on the agenda of the Economic and Social Council. The United States asked that all nongovernmental agencies which now hold and will hold consultative status be granted the same permission as requested for the W.F.T.U. The U. S. resolution was adopted.



A. Z. Abushady of Saudi Arabia supported the U. S. proposal and welcomed the closer relationship of the council which would be thereby granted to the International Cooperative Alliance. Abushady said that his country, in common with all states in the Middle East, is very much concerned with the alliance since it has done much in that agricultural region to educate the people toward economic, social and cultural self-government.

Howard A. Cowden, president of the Consumers Cooperative Association, in the United States, and the organizational sparkplug of I.C.P.A., states the cooperatives will not compete with "oil combines" for private gain and urges that the allocation of Middle East oil be entrusted to the United Nations Economic and Social Council.

World-Wide Yardstick

Eventually, the international co-op hopes to serve as a world-wide yardstick for establishing petroleum prices and to create a pattern for middle-of-the-road economic policy for the nations of the world. And to help create as favorable a world attitude as possible for the petroleum price objective and other co-op plans, the Congress of the International Cooperative Alliance is determined to launch a world cooperative press agency.

With such a press agency in existence, it is certain that all channels will be effectively used to put across, again and again, statements similar to the following which are quoted from the recent co-op Zurich meeting: "A group of leading delegates was unanimous in its conviction that the struggle for oil has been a decisive cause of recent wars and was now the greatest menace to peace. The United States prodigally spent its petroleum resources in fighting World War 2. Within the next 10 years it must import vast quantities of crude oil. The Soviet Union is in almost the same position. Britain cannot remain a great sea power without ample supplies of oil."

Britain's Lord Rusholme (Robert A. Palmer), president of the International Cooperative Alliance, stated: "In my view the cooperative movement can give the only effective answer to the international trusts and combines. . . . The principles of cooperation must permeate the inner life of every nation, thus substituting a spirit of peace, harmony, justice and right for that of competition and rivalry."

It is interesting to note, an oil man here observed, that the new international co-op agency plans to base its demand for U. N. control of Middle East oil primarily upon the basis that the struggle for oil is largely responsible for wars and that it may lead to another. Nothing is said of the age-old Middle East social, racial, and economic problems which predate oil by hundreds of years, he commented.

In relation to the international co-op's demand that Middle East oil be placed under the United Nations, it is perhaps significant that Russia approved this in form but differed in degree. First, it was thought that the Soviet withheld its official approval because of the oil it hopes to develop in northern Iran, when that concession is finally approved. Second, and possibly the better reason, is that Russia visions the co-op's end objective whereby the U.N. would control all the world's oil reserves. That, of course, would include Russia, and Russia, as usually, is playing it safe.

To obtain money for the global co-op program, the I.P.C.A. will have an authorized capital of $15,000,000 of which about $1,000,000 has already been pledged. Plans to start operations hinge on the subscription of the first $500,000 by 10 central organizations. There seems little doubt but what co-ops can easily raise whatever funds they decide are needed. Twenty-two organizations have indicated their willingness to participate. Among them are cooperatives in the following countries:

United States, Sweden, Scotland,

France, Belgium, China, Cuba, the Netherlands, Norway, South Africa, Australia, Iceland, Argentina, Egypt, Finland, Italy, Palestine, Philippines, Puerto Rico, Siam, and Tunisia. England is expected to become a member shortly. Russia, while not a member, has indicated that she will continue to give the co-ops powerful support.

However, financial and moral support, it is hoped, will not be limited to within the co-op ranks. And indications are that this hope is substantial, for insofar as moral support is concerned, the U. S. State Department has already given the I.P.C.A. its fondest blessing. Partially because of this, the International Cooperative Alliance is seeking the creation of a special department to serve co-ops in the International Bank for Reconstruction and Development. This bank was created as a result of the United Nations Monetary and Financial Conference held in July 1944 at Bretton Woods, N. H.

Two Major Problems

That the objectives of the International Bank tie in nicely with the international co-ops' objectives is evidenced from the fact that the International Monetary Fund and the International Bank were designed to help in the solution of two major problems of economic peace: first, how to reconstruct and develop the productive capacity which many nations need in order to achieve a stable economic equilibrium; and second, how to create stable currency and exchange conditions so that each nation can freely and safely trade its products for goods which it cannot itself produce.

It is pointed out that these objectives can be carried out, without a co-op in sight, but is also pointed out the co-ops argue that they can achieve the means to the end in a more logical fashion. And in their consultative capacity to the U. N.'s Economic and Social Council, it is evident and understandable that they will be arguing their own cause, and not that of free private enterprise, at least insofar as the world's oil is concerned.

Strong support for the world co-op's objectives has been officially given by Carl Breuer, official observer for the U. S. Department, at the Zurich meeting, who said that "The United States Government could not but be friendly toward a cooperative movement . . . whose philosphy as regards trade is in harmony with the proposals of my Government for establishment of an international organization to promote multilateral trade by mutually lowering all trade barriers."

Breuer cited Article IV of the Atlantic Charter in which the free access to all raw materials is cited as necessary for all, and added: "Petroleum certainly is one of these raw materials." He said that "plans for setting up a petroleum cooperative owned by the cooperatives in many countries and established for the sole purpose of serving the needs of their consuming members may do much toward realizing this objective of the Atlantic Charter."

Breuer attended the Zurich co-op meeting and spoke with the full cognizance of his superiors in the U. S. State Department.

Oil men here in private industry say they are continually surprised by the co-op statements relating to "equal accessibility of oil to all nations," for this infers that such is not the case at present. And coupled with this puzzling statment observers evidence equal amazement over the co-op resolution, adopted at the Zurich meeting which, in part, states:

"With a view to implementing the Atlantic declaration . . . the Sixteenth Congress of the I.C.A. emphasize in the strongest terms the need for placing the control and administration of the oil resources of the world under the authority of the United Nations and that as a first step in that direction the oil resources of the Middle East should be administered in such a way that cooperative organizations can be assured of receiving their equitable share."

Exactly what is meant by "their equitable share" is not readily understood, one well-known oil source here commented, adding that there is nothing to prevent co-op purchasers from buying Middle East oil on the same basis as other buyers. And as a matter of fact, he added, there is nothing to prevent them from conducting the same expensive exploratory methods which have resulted in the discovery of oil in the Middle East and elsewhere. And contrary to some thinking, it was said, there are excellent potential oil areas in the Middle East not already under concession.

However, the United Nations Economic and Security Council may not be as readily informed when the oil question arises, for the inference from the co-op statements is that Middle East oil is available only to a preferred group. Nothing could be so far from the truth, it was said, and it is clear that factual statements are necessary "if this type of spurious global-oil reasoning is continued."

Meanwhile, the International Cooperative Alliance and its affiliated International Cooperative Petroleum Association are working on the theory that "free trade is dead" and that "controls are essential now as we move into a planned economy."

Exactly what form the opposition will take to the world co-op views remains uncertain at the present date. But all indications are that the objectives, charges and inferences will not go unanswered.

The proposal of the international cooperative organization that Middle East oil be placed under United Nations control, interests Russia in its role as one of the world's major powers. The Soviets operate a sizable state-dominated oil industry of their own, and Russian engineers are now seeking to expand production in such areas as Uzbekistan's Ferghana Valley, where the operation shown here is taking place. Sovfoto, which distributed the picture, described the crew as one of the best working in the Palvan-Tash field

WASHINGTON WATCHING

BY HENRY D. RALPH

Truman on Conservation

WASHINGTON. — A hint that the federal Government may seek a more active role in conservation was contained in President Truman's State of the Nation message January 6 when he said:

"I must advise the Congress that we are rapidly becoming a 'have not' nation as to many of our minerals. The economic progress and security of our country depend upon an expanding return of mineral discovery and upon improved methods of recovery. The federal Government must do its part to meet this need."

It is possible that further details of what the president has in mind may be disclosed in his later economic and budget messages.

Much of the message was devoted to means of improving labor-management relations, including creation of a commission to make recommendations to deal with the "special and unique problem of nation-wide strikes in vital industries affecting the public interest," and the president mentioned the oil industry as one example.

Another major point made by Mr. Truman was the "growing concentration of economic power and the threat to free competition in private enterprise." He promised vigorous enforcement of the antitrust laws and asked for positive measures of aid to new enterprises, assistance to small business, and special attention to decentralization of industry.

Plaudit for PAW

THE highest type of praise for the Petroleum Administration for War runs through the year-end report of the House petroleum subcommittee, together with commendation for the new Oil and Gas Division and the National Petroleum Council.

In its review of the wartime petroleum problems and their solution, the committee uses such language as this:

"It seems clear that the able and effective organization, representative of both the Government and petroleum industry, contributed splendidly to the stupendous petroleum supply task. The committee feels that because of the importance of this organization of the Government and industry and the cooperation between the two, a plan of a practical effective cooperation was evolved which may well be emulated in other agencies of government. . . .

"The accomplishment of PAW had demonstrated the value of another basic principle of organization, namely, the wisdom of staffing the oil agency with men experienced in practical petroleum operations. Approximately three-fourths of the executive and technical staff of PAW came from oil companies, large and small alike, or from fields closely associated with the oil industry, such as engineering firms, equipment suppliers, and the like. None of these men was appointed on a part-time or a dollar-a-year basis; they were all regular full-time government employes."

After describing the organization of OGD and the council, the committee says:

"This setup in peacetime represents in some respects a new departure in the theory of government-industry relations.

"The committee regards the creation of the NPC as a significant development, a natural outgrowth of the cooperative accomplishment experienced during the war. Prior to the war, relationships between the petroleum industry and the federal Government were anything but close and harmonious. Machinery did not exist for enabling the industry to contribute effectively out of its practical experience and to give Government the benefits of information and recommendations upon problems of common and public concern.

"This alliance, if a genuinely cooperative relationship is maintained, will benefit both the Government and industry in terms of a better understanding of petroleum problems, and an improved governmental administration of oil and gas activities."

"Petroleum Security" Report

A NINE-POINT program to provide "petroleum security" for the United States is offered in a report filed with Congress December 30 by the outgoing petroleum subcommittee of the House committee on interstate and foreign commerce.

Presented by Chairman Clarence F. Lea of California, the report summarizes the hearings held during the past year as part of the committee's program of keeping abreast of oil developments, stressing particularly the presentation made last spring by the Petroleum Administration for War reviewing wartime activities and forecasting the problems of postwar.

Rejecting the alarmist view that the country is "running out of oil," the committee nevertheless takes the position that prudent consideration for a long-range supply requires some sort of forward-looking program on the part of both Government and the industry. The report says:

"The ever-present question of a long-range supply of petroleum products or other equivalents for the future use of the nation is of necessity a matter of concern to the country. Perhaps no other industry has contributed more to the economic progress of our country in the last 50 years than that of the petroleum industry. The quantity of available oil in the earth is unknown to all. There is unquestionably a great supply, but we are certainly consuming an exhaustible supply with uncertainty as to how much the known supply may be augmented by future developments.

"During the war years the United States actually produced one-fifth of all the oil produced in this country since the Drake well was completed in Pennsylvania in 1859. This was a heavy, though a necessary, drain upon a vital and exhaustible natural resource. The future oil supply of the United States, when measured in terms of prospective peacetime and emergency demands, is sufficiently uncertain that prudence demands we follow a comprehensive policy of petroleum security. We should adopt a consistent plan of further exploration and development, promote more and better conservation, and assure a greater security for future needs."

Suggested Possibilities

The following are some of the possibilities which ought to be pursued as part of a program to promote the necessary petroleum security:

"(a) The exploration and development of the sedimentary basin along the North Alaska Coast. This area comprises about 75,000 sq. miles of the public domain. Of the total, about 35,000 sq. miles is a naval petroleum reserve under jurisdiction of the Navy. The remainder, under the jurisdiction of the Interior Department, has been withdrawn from entry. The committee is informed that the prospect of finding oil outside of the naval reserve is probably equally favorable to the prospect within the reserve.

"(b) Exploration and development work on the Continental Shelf should proceed vigorously despite the many technical difficulties that will doubtless be encountered.

"(c) Research to advance the technique of secondary recovery to make

available the large volume of unproduced oil remaining in the older oil fields of the United States.

"(d) States which have no oil and gas conservation laws applicable to their conditions might now consider the enactment of such legislation. Such laws can now be written with knowledge of the years of experience of other states which have such laws. . . .

"(e) Improvement in the conservation practices in states which have enacted adequate legislation. The effectiveness of such legislation depends largely upon the support given to it by the industry. Industry can also help by actively supporting the unitized operation of oil fields wherever practicable. The flaring of natural gas in substantial volume continues in cases where unitization of operations might make possible the reinjection or other use of this gas.

"(f) There is need for continued information and concern as to keeping production within the limits of maximum efficient operation.

"(g) Research in the synthetic production of alternative fuels for various purposes from natural gas, coal, and oil shale, and any other promising source should be continued, with the active cooperation of industry. The research might well be directed at serving specific needs, such as jet-propulsion fuels, diesel oils for submarines, and heating oil for homes.

"(h) Discussion might be carried on with the nearby foreign countries, such as Venezuela, Colombia, and Mexico, designed to assure provision of mutual petroleum supply in the event of war which involves or threatens the Western Hemisphere. . . .

"(i) Between 300,000 and 400,000 bbl. daily of petroleum and its products are now being imported. With domestic demand increasing, it is to be expected that imports may gradually increase. In view of the importance of available foreign sources of oil, the committee considers it to be essential that the United States pursue a forward-looking foreign oil policy so that foreign sources of oil may remain open to American trade and on terms not obnoxious to friendly nations."

OGD's New Director

AT 12:10 p. m. January 3, Max W. Ball raised his right hand and promised the chief clerk of the Interior Department to defend the Constitution of the United States against all enemies, foreign and domestic. Then he and Mrs. Ball shook hands with Secretary Krug, who welcomed him as the new director of the Oil and Gas Division, following which he was greeted by half a hundred members and officials of the department.

Then Director Ball crawled under a painter's ladder into his redecorated office and plunged into the little matter of figuring how to induce the economy-minded Congress to appropriate enough funds to permit the new division to organize the kind of staff it wants.

But first he stopped to get acquainted with the group of Washington oil writers, calling them by their first names and ducking no questions. In affableness, at least, the rotund, jovial Ball is in marked contrast to his predecessor, shy, reserved, Ralph K. Davies, though they appear to see eye to eye in the objectives of OGD and in opposition to government regulation of industry.

Ball envisions no grandiose bureau, but a small, compact, service organization, staffed with the highest type of men he can get, men who are specialists in the main phases of the oil and gas business. OGD won't attempt to cover every aspect of the industry but will call in consultants for special jobs, and its value, he believes, will be in knowing where to get the right men for particular problems.

OGD is planned as a trouble-shooting and policy-making agency for all other federal bureaus, within and without the Interior Department; also a father confessor and friend at court for the industry when it has government troubles. For this OGD is seeking a budget of a little under $500,000 —a small amount as government agencies have gone in recent years.

One thing Ball is outspoken about is his deep-seated opposition to government paternalism and regulation of industry. He firmly believes that the workings of free competition and private enterprise are far better than the alleged security of a regulated economy, and to prove his position he presses on visitors copies of speeches he made praising private capitalism when it was unpopular to do so.

Suspicious Bureaus

MAX BALL'S first official job as director of the Oil and Gas Division was to preside at a meeting of the interdepartmental petroleum coordinating committee which for the past 6 months has unenthusiastically been making a study of the oil and gas activities of the entire federal Government with the view of eliminating duplications and conflicts. The lack of enthusiasm was on the part of the agencies other than OGD, for they have harbored a deep suspicion that the new agency was out to take away their functions—and appropriations.

Max knew about this so he started off by announcing that he is not empire-building and not going on raiding expeditions, meaning that he doesn't want a big organization and isn't going to absorb large hunks of other agencies, even though such authority might be implied in President Truman's letter creating OGD.

The survey has shown a certain amount of duplication of effort among two or three bureaus collecting statistics and doing research on oil and gas matters, and some of this can be eliminated without too much of a fuss. It is also pointing to some activities which can be done more advantageously in some other place, and efforts will be made to engineer some shifts. But more important than these, it has shown that a good deal of work needs to be strengthened and perhaps reoriented but kept in its present agency.

Moore Seeks to Continue Special Senate Committee

WASHINGTON.—Sen. E. H. Moore of Oklahoma intends to sponsor a resolution to continue the special Senate committee on petroleum resources, of which he was ranking Republican member in the last Congress.

The committee has officially expired but has until the end of January to complete its report, which is now being written by the outgoing chairman, Joseph C. O'Mahoney of Wyoming.

Calling attention to the fact that Interior Secretary Krug suggested continuation of the committee to provide liaison between Congress and the oil industry, Moore said it might be desirable to have a permanent standing committee on petroleum in the Senate. He added that the oil and gas rights on public lands give the federal Government a toehold into the petroleum industry which he said should be eliminated and the Government should divest itself of oil and gas ownership.

Oklahoma Gasoline Drops 2 Cents as Tax Expires

OKLAHOMA CITY. — Oklahoma's gasoline taxes, highest in the nation until last week, dropped 2 cents a gallon January 1 with the expiration of a special tax levied to finance a construction and maintenance program for highways and farm-to-market roads.

The expiration of the tax, in effect since April 1945, dropped state gasoline taxes from 7½ to 5½ cents.

Supreme Court Declines To Consider Rate Case

WASHINGTON.—The Supreme Court early this week for the second time declined to consider an appeal of Cities Service Gas Co., seeking a $25,000,000 rate refund affecting several southwestern cities.

The court declined to consider the case November 12 and on being asked to reconsider its rejection, again refused to accept jurisdiction.

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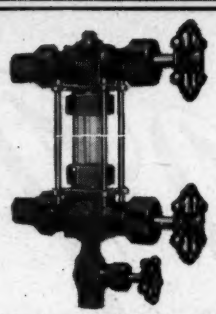

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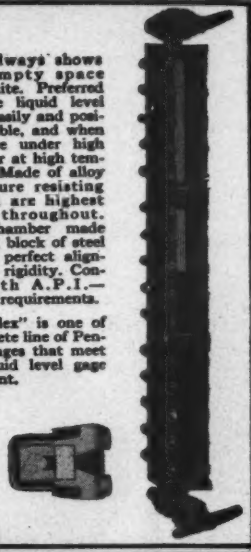

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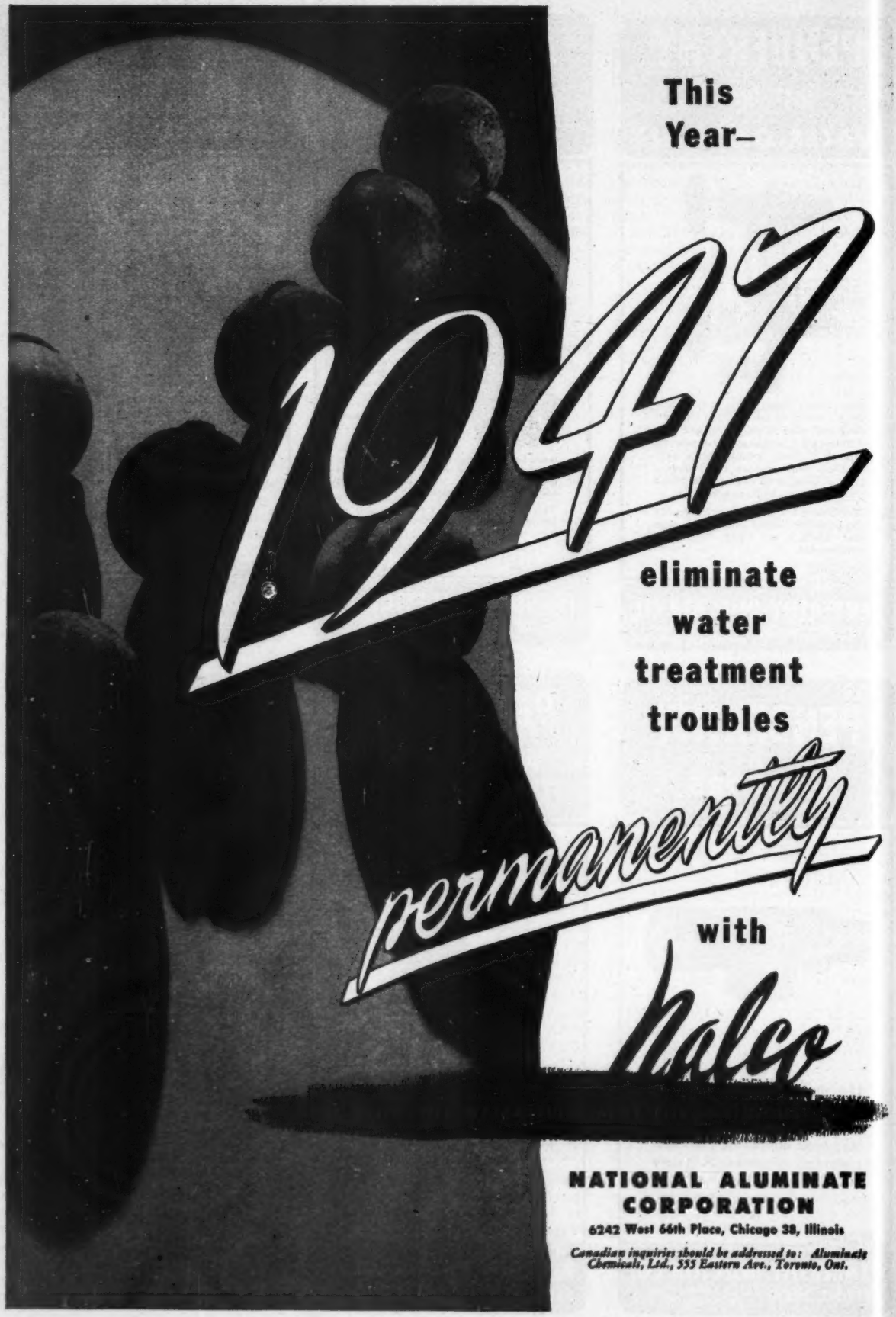
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Suppliers Limit Burning-Oil Customers as Demand Grows

CALLS for heating oils of all types are swamping midwestern and Mid-Continent suppliers as the industry moves into the season of peak winter demand.

Reports indicated trading in these products was under conditions of a definite sellers' market. Refiners generally were said to be taking orders only from regular customers and even limiting some of these.

Some market observers felt an upturn in the prices for the burning-oil group of products is overdue. One refiner reported spot sales of No. 2 at 5¼ cents—⅜ cent over the present market. The same supplier said he is sold up through the remainder of the winter except for small quantities of No. 2.

Tank cars were reported in short supply, though one informed sales official said he had received reports the shortage is definitely eased. One refiner reported being some 100 cars behind on shipments but expected to make deliveries on schedule within the next 2 weeks. A marketer described tank cars as "a real problem" and said slow rail movement is resulting in, for example, a 3-week round trip time to Minneapolis from Group 3 territory.

An unusually small amount of distress gasoline was reported on the market considering the season. Major companies with large storage facilities were said to be storing much motor fuel in anticipation of another summer of unprecedented consumption.

Prices appeared to be firm, despite some under-the-market offerings of small refiners ranging down to 6½ cents for regular grade.

Standard Oil Co. (Ind.) announced in Chicago that it would increase its tank-wagon prices January 7 to conform to the higher freight rates that went into effect January 1. The increases will cover gasoline, refined oils, tractor fuels and distillates and are expected to be generally in the 0.2 to 0.3-cent range. Freight rates were raised 20 per cent up to a maximum of 6 cents per cwt. (about 0.4 cent per gallon on gasoline) over rates prevailing last June before a 6.5 per cent temporary increase was authorized.

Meeting heavy requirements of regular customers continued to tax suppliers of lubricating oil. High-quality lubricating oil was in particular demand in the midwest. Many suppliers were operating on a pro rata basis with customers. Bright stock, 200 vis. D, 0-10 p.p., was said to be bringing about 28 cents where available.

In North Texas, demand for natural gasoline, kerosene, and burning oils continued strong. Kerosene was in especially strong demand with shipments retarded due to lack of tank cars.

The combination of cold weather and the possibility of a tugboat strike firmed up the No. 2 and kerosene market in New York. Stocks of the two products, excessive several weeks ago because of the mild autumn weather, were reported "ample." New York residual stocks were lower, and the possibility that residual prices will rise 10 to 20 cents a barrel within the next few weeks was seen in some marketing circles.

Penn Grade Prices Up 10 Cents

PENNSYLVANIA-grade crude oil has been given its fifth price increase in the last year with a new 10-cent advance posted by purchasers effective January 1.

The latest increase means a further cut in payments under the federal stripper-well subsidy program which has been already eliminated throughout the United States except for the Pennsylvania-area production.

In the Mid-Continent and Southwest areas, minor adjustments in the price of crude from various fields was made by several companies effective the first part of January. Fields and areas affected by these adjustments were eastern Illinois-western Indiana, Baxterville, Miss., and Minnie Bock, Tex.

The new Pennsylvania-crude increases raise the price of Bradford district oil to $3.65 per barrel. A year ago, this type of crude brought $3 exclusive of a 75-cent government subsidy.

As a result of the new postings effective January 1, the subsidy is now entirely eliminated for Buckeye and Eureka grades of Pennsylvania crude and is reduced to 6 cents per barrel for southwestern Pennsylvania grade, and to 20 cents per barrel for Bradford and Allegany grades.

The new crude prices announced by Joseph Seep Purchasing Agency of South Penn Oil Co. follow:

Allegany district oil in Bradford Transit Co.	$3.65
Bradford district oil in Bradford Transit Co.	3.65
Bradford district oil in National Transit Co.	3.65
Bradford district oil (Tiona) in National Transit Co.	3.65
Pennsylvania grade oil in South West Penna.	3.44
Pennsylvania grade oil in Eureka Pipe Line Co.	3.44
Buckeye-Pennsylvania grade oil in Buckeye Pipe Line Co.	3.40

Gulf Refining Co. announced a price change on purchases of crude oil in the Baxterville, Miss., field, effective January 3. The new posting is $1 per barrel for below 20°-gravity crude. Previous posting was $1.16 per barrel. The gravity basis of below-20 gravity, on which the former price was made, has been eliminated inasmuch as there is no production in the field above 20° gravity.

Ohio Oil Co. posted effective January 1 a gravity-scale price for eastern Illinois-western Indiana crude, ranging from $1.68 for below 29° gravity with a 2-cent differential to $1.82 for 35° and above. Formerly, the company posted a flat price of $1.67 for the crude.

Sinclair Prairie Oil Co., crude-marketing division, issued a new schedule of crude prices effective January 1. The schedule placed Minnie Bock with Mirando Texas heavy-type crudes carrying a price from $1.66 for below 24° gravity to $1.78 for 29° and above. Formerly, the field was in a lower-price gravity scale column. The company made a new posting for Captain Lucy field in Texas.

DEATHS

Morris S. Rhoads, 54, Texas independent operator for many years, died January 4 at his home in Fort Worth.

Robert R. Grandin, 50, former drilling contractor, died January 5 at his home in Bristow, Okla.

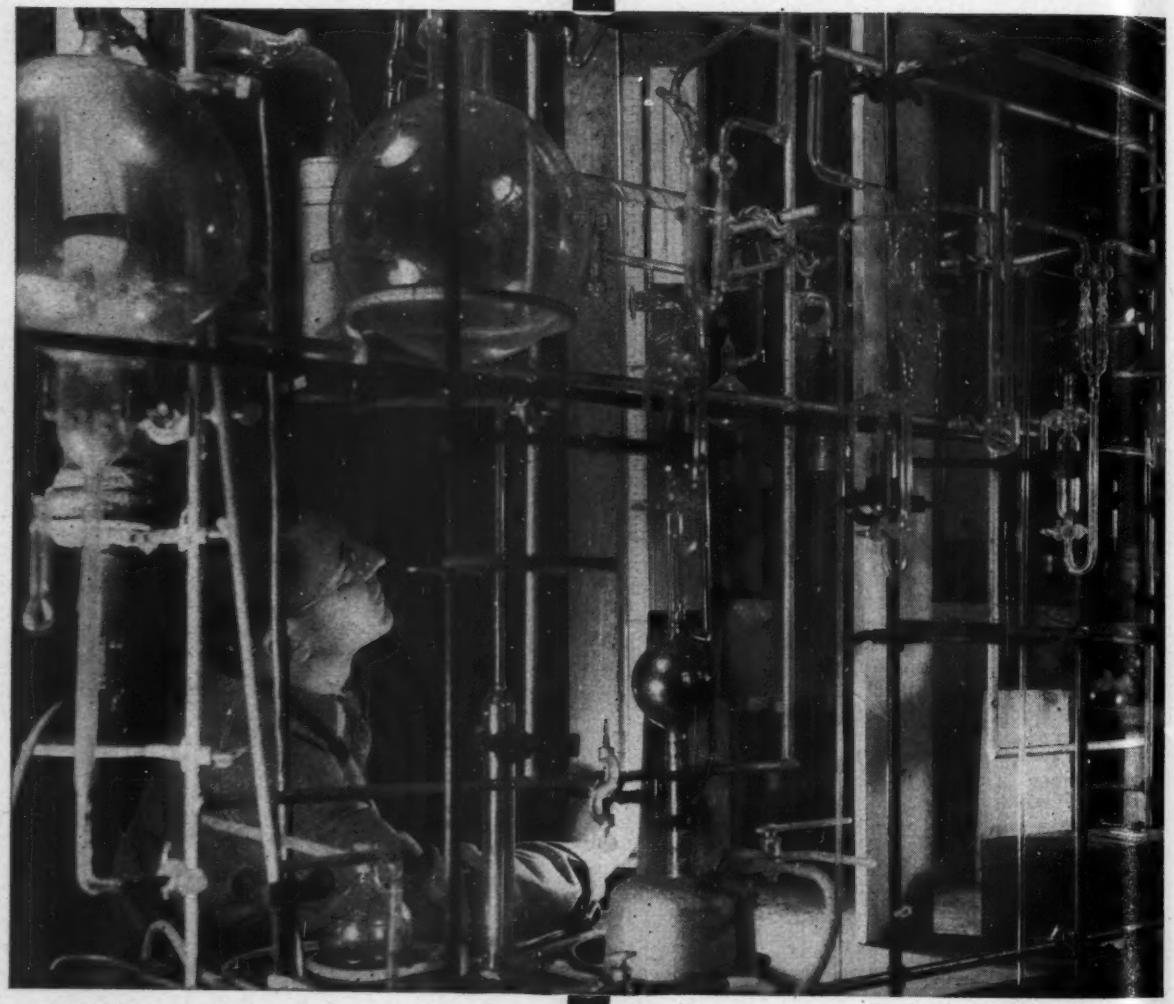
Joseph W. Carney, 58, former assistant manager for Standard Oil Co. (N. J.) in China, died in New York December 31. Carney had been associated with Standard Oil interests for 30 years and retired in 1941. During the war he was executive secretary of the foreign-operations committee, Petroleum Administration for War.

R. M. Dinges, 45, vice president of Continental Supply Co., Inc., New York, died December 31 at his home in Forest Hills, N. Y.

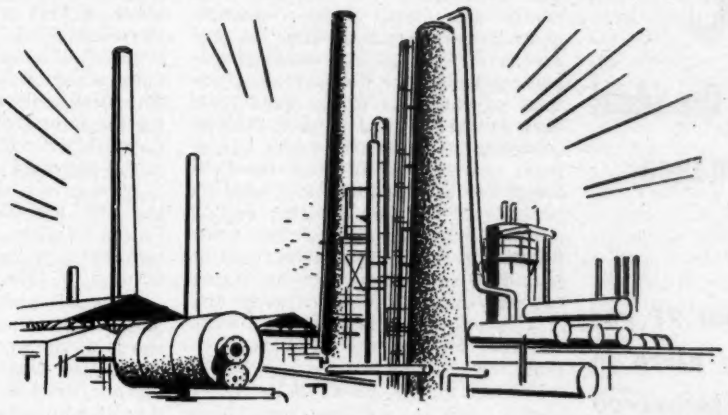
George S. Hiland, 50, civil engineer with American Liberty Oil Co. for 12 years before opening his own office 8 years ago in Dallas, died December 31 in a Dallas hospital.

Tobias B. Weaver, 75, retired Kansas drilling contractor, died December 30 at his home in Wichita.

WORK



THAT'S NEVER COMPLETED



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It's the reason, too, why the industry can, with every confidence, look to Universal for continued progress in the unceasing job of developing processes to improve the quality and yield of petroleum products.

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UNIVERSAL SERVICE PROTECTS YOUR REFINERY

Benton Unit

. . . approaches the ideal pressure-maintenance project

It is estimated that 91 per cent of liquids in place in reservoir may be recovered in this Louisiana field

by George Weber

CUMULATIVE experience in dealing with high-pressure gas-condensate production plus a growing record of the benefits of unit operation are contributing to greater conservation of such reserves. The immediate need of foresighted plans for unitization, field development, and cycling of newly discovered reserves cannot be overstressed.

As an outstanding example of prior planning and early preparation for cycling, the Benton unit (Bossier Parish, Louisiana) in its current initial stage appears to approach most nearly the ideal pressure-maintenance project. From the time the discovery well tested high-pressure gas and condensate, the thoughts and efforts of operators in the field have been directed toward ultimate cycling.

Unitization under a model agreement was completed when the field comprised but three wells. Under its provisions the unit is being drilled with a minimum number of wells which will serve the dual purpose of providing subsurface data for fixing the unit area and equities in it, and serving as producing and input wells for the pressure-maintenance program.

Production has been almost completely shut in, awaiting completion of the cycling plant now building. The pressure-maintenance program involves injection of water as a make-up for shrinkage of processed gas. As a result of these farsighted provisions, the Benton field, on the basis of reserves in place, should provide a new record for recovery at a development cost unmatched in the cycling industry.

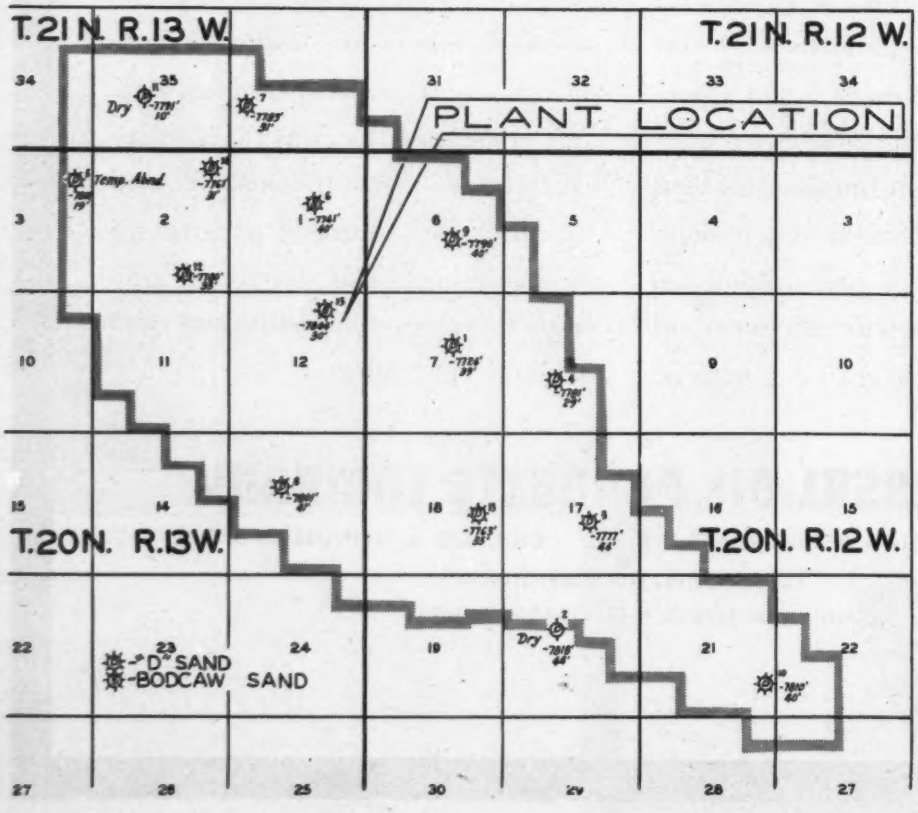
Field History

Gas-condensate in this North Louisiana field occurs in sands of the Cotton Valley series. The reserve is similar to but smaller than that incorporated in the Cotton Valley unit 15 miles to the northeast.

The Benton structure first was indicated from gravimeter surveys made in 1943 under the direction of Barnsdall Oil Co. The anomaly checked closely with seismograph data obtained later the same year. The first well, drilled by Barnsdall for the joint account of this company and Sohio Petroleum Co., was located at the indicated crest of the structure. It encountered gas and condensate in the "D" and Bodcaw sands of the Cotton Valley formation and was completed in the former sand in the autumn of 1944.

Barnsdall and Sohio hold in joint half interest approximately two thirds of the acreage now considered productive. Nearly all of the remaining one third is held under lease by the Vaughn interests, comprising G. H. Vaughn, G. H. Vaughn Producing Co., G. H. Vaughn, Jr., Jack Vaughn, and Ed E. Hurley. Minor tracts amounting to about 1½ per cent of the present unit area are held under lease by Continental Oil Co., Mid-States Oil Corp., Union Producing Co., and others.

Once the Benton reserves proved to be the type requiring cycling all plans for developing the field became directed to that end. With only the geophysical picture to guide them, the three major interests decided to determine as soon as possible the productive limits of the field without resorting to excessive offset drilling to the field's edges. The second and third tests were drilled by Barnsdall-Sohio and Vaughn on what was believed to be the south and northwest edges of the field. Both semi-wildcats penetrated the entire Cotton Valley series, testing all forma-



Shaded line on map (left) shows outline of unitized area of the Benton field, Bossier Parish, Louisiana. Development to date in each of the two producing horizons is indicated

tions which appeared worthy of testing. Thin gas-condensate sections immediately above the water level were found in the "D" sand and the Bodcaw sand showed water in both wells. Although neither test proved commercially productive, valuable subsurface information was obtained and the close accuracy of the geophysical picture of the structure as indicated.

Two additional wells located higher on the structure southeast and northwest of the discovery well proved "D" sand production, limited the Bodcaw pay on the southeast and showed gas condensate and a thin oil section in the Bodcaw sand northwest of discovery. The information from these wells provided operators with the needed assurance of sufficient reserves to cycle and unitization plans began immediately.

While attorneys commenced work on the agreement itself, geologists with the three companies principally concerned pooled their information and fixed tentative outlines of "D" and Bodcaw sand production. Together with company engineers they selected locations for future wells which would best provide data on the structure and later fit into the cycling plan. Pending completion of the agreement, operators voluntarily closed in their wells to prevent undue pressure decline in the reservoirs. This was considered important, since laboratory study indicated that the initial reservoir pressures were near the critical point below which condensate would separate underground and become irrecoverable.

Operators' Agreement

The unit operation agreement was completed and executed by Barnsdall, Sohio, and the Vaughn interests on January 1, 1946. It is principally noted for the timeliness of its drafting which occasioned departures from the form of agreement usually contracted for fields of more advanced development. It incorporates the common features of such agreements concerning definitions, titles and title examinations, designation of operator, construction and operation of cycling and pressure-maintenance plant, disposition of production, accounting practices, etc. In addition it provides for development of the field itself and anticipates at a time when extent of reserves was not definitely known, the eventualities of unit operation upon completion of the drilling program.

Barnsdall Oil Co., because of its operation of the major interest and its lead in the field program, became operator of the unit. All gas, condensate, or oil occurring between the base of the Travis Peak formation and the top of the Buckner formation, or if missing, the top of the Smackover lime, are unitized. Limits of the unit as shown in the accompanying map were fixed along the boundaries of 20-acre tracts to include all acreage believed by company geologists to be productive at the time the agreement was signed. Therefore, the instrument provides not only for inclusion of additional acreage in the unit, but exclusion of presently unitized tracts, on the basis of final determination of field limits.

When the agreement became effective, three producing wells and two dry holes had been drilled in the unit and a sixth well was drilling. On that date, all six wells plus their equipment were turned over to the operator of the unit for any uses considered desirable for conducting the unit operations. No adjustment relative to cost of or investment in these wells was made between the participants. The wells were redesignated Benton Unit Nos. 1 to 6.

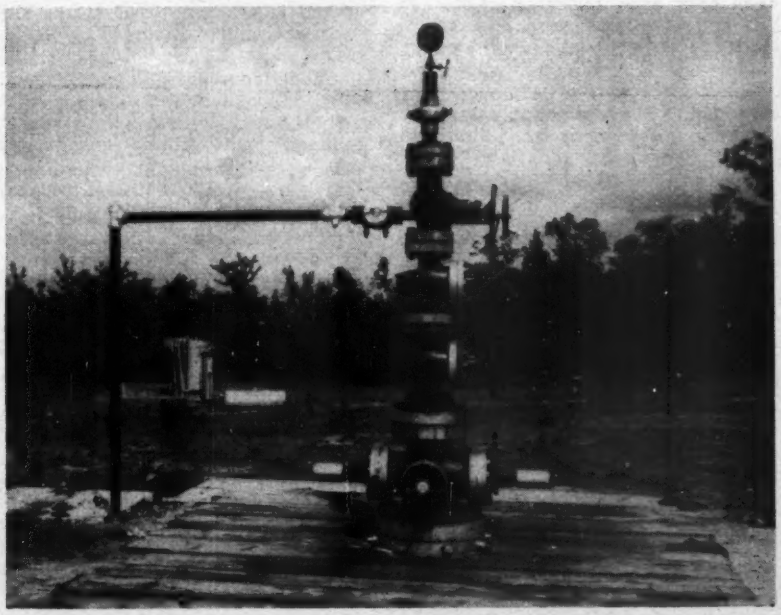
The unitization contract called for further development of the field in three steps: (1) Drilling of four wells whose locations were agreed to by all parties; (2) subsequent drilling of four more wells whose tentative locations were subject to change dictated by results of the first four wells; and (3) further drilling as seen necessary to the unit program and opproved unanimously by all parties.

In these initial stages of operation, all costs and expenses are borne by members of the agreement in proportion to their holdings in the unit area on a straight acreage basis; an arbitrary basis employed temporarily. Completion of the eight wells provided in the contract signaled the beginning of a detailed field study to determine the reserves in place and participation of all parties in the unit on that basis.

Computing Equities

Fixing of equities at Benton follows a new course believed the fairest and most impartial yet incorporated in such a project. All pertinent field information in the possession of all parties was made available to a disinterested consultant, in this case the geological and engineering firm of DeGolyer & MacNaughton of Dallas. This consulting firm is employed to determine the value of economically recoverable reserves in place under each separate tract in the field as of the effective date of the agreement. For the purpose of converting reserves to a value basis, methane, ethane, propane, and 20 per cent of butanes are considered gas, worth 4 cents per 1,000 cu. ft., and all other hydrocarbons are classed as liquid, valued at $1.25 per barrel. On completion of the first valuation of reserves, equities of all parties in the unit agreement will be computed and corrections in participation will be made retroactive to the agreement date.

One year later, the same firm will repeat the field valuation, making corrections necessary in light of new data obtained during the interim. This second valuation will be considered final. It will fix the minimum limits of the unit area which may be expanded only upon proof of extended production. It will also form the basis for the determination of final equity percentages in the unit which, barring later field extension, shall apply unchanged to depletion



Benton wells are produced only for the purposes of testing and supplying drilling fuel within the field, pending completion of the cycling plant. No. 3 well, here shown, encountered gas condensate in both the "D" and Bodcaw sands

of the field. Corrections required by the final equity determination will also apply back to the date of the agreement.

At present, the eight wells called for in the agreement have been completed and an additional well has been authorized by unit members and is now being completed. It is probable that other wells will be drilled before the final estimate of reserves is made a year hence, in order to provide more detailed information on the undrilled portions of the field and to facilitate more efficient sweep of dry gas through the reservoirs.

According to terms of the agreement, on completion of the eight wells referred to above, the operator prepared and submitted to all other parties, plans and specifications for a pressure maintenance system. Nonoperators were allowed 30 days in which to make objections or to recommend changes or amendments to the plan. Following approval of a plan by all parties, bids were invited from at least three contracting firms, for construction of a cycling plant either on a cash basis or out of production. Contract for the plant, which will cost $3,500,000, was let to West & Cole of Houston.

Each party may elect to take its equity percentage of plant products from the unit in kind, but must offer to share ratably with other parties any market it secures for such products. Furthermore, any party purchasing additional leases on any tract in the unit must notify all other parties who shall be entitled to purchase interests in such leases in proportion to their equity percentages. In the event any party wishes to sell his interest in the unit, or any undivided portion of his interest, such may be done only after receipt of a bona fide offer from a purchaser and then only after all other parties in the unit have been given the opportunity to purchase the same interests under identical terms and conditions.

The agreement expressly states that it is not the intention of parties to form a partnership or association, and duties, obligations, and liabilities of parties in the unit are several and not joint or collective.

State Order Issued

Shortly after the signing of the agreement, the parties made application to the Louisiana Department of Conservation for a hearing on the field. At this hearing, held in March 1946, various representatives of Barnsdall Oil Co., on behalf of the operators, submitted complete data concerning the field and unit agreement. Geological aspects of the field were presented by Claude Valerius, district geologist, Shreveport; data on completion of wells and production and well-performance characteristics by Herbert F. Beardmore, chief engineer, Tulsa; details of core analyses and reservoir interpretation by W. L. Horner, manager of the secondary-recovery department, Tulsa; and information on the proposed plant design and recoveries by H. W. Manley, superintendent of the gas and gasoline department, Tulsa.

Following the hearing, the Department of Conservation issued order No. 114 which defined the Benton field and ordered the following:

1. Development and operation of the "D" and Bodcaw sands as a cycling and pressure maintenance unit.

2. Pooling and unitization of all separate ownerships of the two reservoirs in the pool, including perfect ownership, mineral interests, royalty interests, and oil and gas leasehold interests, subject to the department's approval of the DeGolyer valuation and a royalty owners unitization agreement.

3. Shutting in of all Benton wells except for testing and production of drilling fuel, until cycling operations begin.

Blanket permits were issued for drilling the proposed eight wells outlined in the agreement, and Barnsdall Oil Co. was recognized as operator of the unit.

The Field

As shown on the map and brought out in testimony at the hearing, the Benton unit at present embraces a total of more than 10,000 acres. The outline of unitized acreage will be changed to conform to the revised —7,820-ft. contour on the "D" sand which approximates the water level in that sand. However, the unusual accuracy of the original geophysical picture can be seen in the relatively close relation between the unit as originally outlined, and the limits of production as now estimated.

The principal reservoir is the "D" sand which varies in total thickness from 10 ft. on the northwest to over 40 ft. on the southeast end of the elongated fold. It is continuous over the entire structure and shows high permeability and porosity. No evidence of faulting has been found. The direct contact of gas and water in flank wells proves that there is no appreciable oil in the "D" sand at Benton.

Since the water contact is higher on structure in the Bodcaw sand, it is productive over a much smaller area than the "D" sand. Porosity and permeability also average less in the Bodcaw, and production on the northwest flank of the structure appears to be limited in both sands by low permeability rather than by the water contact. The presence of a thin section of oil saturated sand was established in the Bodcaw sand in No. 6 well. Although operators made every effort to complete the well for an oil producer, it resulted in a combination well producing a mixture of gas, condensate, and oil. The Bodcaw sand is considered predominantly a gas-distillate reservoir. Data on sand characteristics based on early development work in the field are listed in an accompanying table.

The "D" sand reservoir has shown a very high pressure transmissibility on field-wide tests. In March, very accurate bottom-hole pressure tests were made on wells Nos. 1, 3, 4, and 7.

(Continued on page 86)

TABLE 1—RESERVOIR DATA*—BENTON FIELD

	"D" sand	Bodcaw sand
Gross thickness, feet	10-44	
Average porosity, per cent	19.8	15.8
Average permeability, md.	146	53
Average oil saturation, per cent		12.9
Average water saturation, per cent	30.8	22.5
Initial reservoir pressure, psi.	3,745 at 8,000 ft.	3,758 at 8,050 ft.
Initial reservoir temperature, °F.	224 at 8,000 ft.	
Estimated reserves in place:		
Gas, billion cubic feet	192-213	35
Liquid, barrels	15,230,000	1,700,000

*Based on data presented before Louisiana Department of Conservation.

TABLE 2—WELL-COMPLETION RECORD—BENTON FIELD

Well No.	Showed in "D"	Showed in Bodcaw	Comp. in	Remarks—
1	GD	GD	"D"	Discovery well
2	SW & GD	SW	Abd	Few ft. GD in top "D." Proves no oil in "D" sand
3	GD	SW	"D"	
4	GD	SW	"D"	
5	GD & SW	SW	"D"	Bodcaw tight. Well produced 3 months then shut in
6	GD	Oil & GD	Bod.	Produces mixture oil and gas, proves thin oil section in Bodcaw sand
7	GD	Tight	"D"	Bodcaw showed zero perm.
8	GD & SW	SW	"D"	PB top "D" & comp.
9	GD	SW	"D"	
10	GD & SW	SW	"D"	
11	Tight	Tight	Abd.	High enough for "D" production but too tight to produce
12	GD	SW	"D"	
13	GD	SW	"D"	
14	GD	SW	"D"	
15	GD	Oil & GD	....	Preparing to complete in Bodcaw sand

GD—Gas distillate. SW—Salt water.

New Diesel-Electric Barge Rig Designed for Routine Drilling to 15,000 ft.

THE largest, most powerful barge drilling rig ever built by Humble Oil & Refining Co. is now successfully completing its first well at Bayou Sale, 15 miles south of Franklin, La.

A power plant consisting of three 700-hp. 900-r.p.m. supercharged diesel engines, a 1,000-hp. draw-works motor which can be overloaded to 1,500 hp., a new system of main generator control which automatically varies motor speed with load demand, and air-operated brakes are some of the major features of this unique barge rig. Designed to operate in approximately 10 ft. of water, this rig is particularly well adapted to wildcat drilling in areas where fuel and water would be difficult to obtain for other types.

This drilling unit consists of a power barge and a drilling barge. The drilling barge is a twin-hull type 140 ft. long, 54 ft. wide, with 12-ft.-deep hulls. The design of this barge differs from the conventional twin-hull type in that the individual barges are offset and the 6-ft. slot extends 86 ft. from the forward end rather than the entire length of the hulls, thus providing more usable space on the afterdecks of the hulls for the mud pumps and mud-pump-manifold piping. Each hull is divided into six main compartments and two collision compartments by means of a longitudinal bulkhead and four transverse bulkheads. All main compartments are used for submergence water except the two center compartments in the starboard hull which are used for fresh-water storage. When raising the barge off location submergence water is pumped out by six vertical centrifugal pumps driven by electric motors.

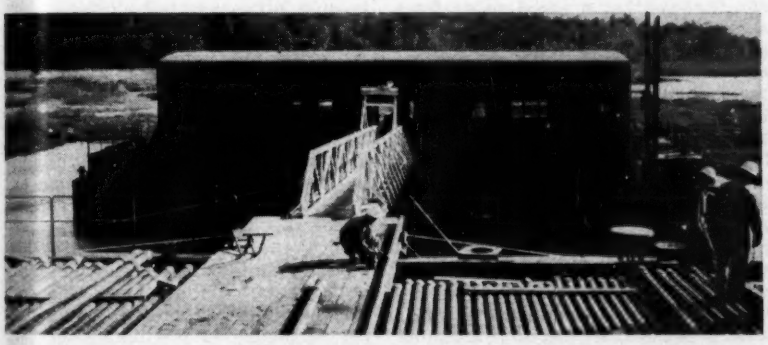
The power barge is 100 ft. long, 30 ft. wide, and has a 12-ft.-deep hull. The hull is divided into eight main compartments: four outboard compartments, two on each side being used for submergence water, three of the inside compartments for fresh water storage, and the other for fuel oil. This barge is equipped with four motor-driven vertical centrifugal-type pumps for handling the submergence water.

Three 700-hp., 900-r.p.m. supercharged diesel engines, each direct connected to a 375-kw. generator with a 60-kw. constant-voltage generator mounted on top and driven by V-belts from the main generator shaft, furnish power for the rig. The 60-kw. generators are equipped with Thyrite-controlled exciters so that the voltage generated remains constant though the engine speed may vary. Each engine is provided with a closed cooling system consisting of a tube-type heat exchanger and a motor-driven raw-water pump. The jacket water is circulated through the engine and heat exchanger by a pump built on the engine. The raw water is also pumped through a small heat exchanger for cooling the lubricating oil.

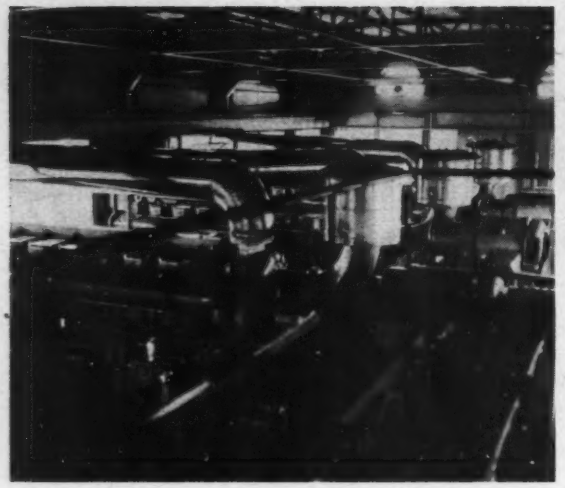
Of particular interest, in connection with the power plant, is the use of electro-hydraulic governors which automatically adjust the engine speed as the load demand varies. The speed of the engines therefore may vary from 450 to 900 r.p.m., depending upon the load demand. Since the electro-hydraulic governors permits use of the lowest possible engine speed under any given load demand, engine wear and fuel consumption are held to a minimum.

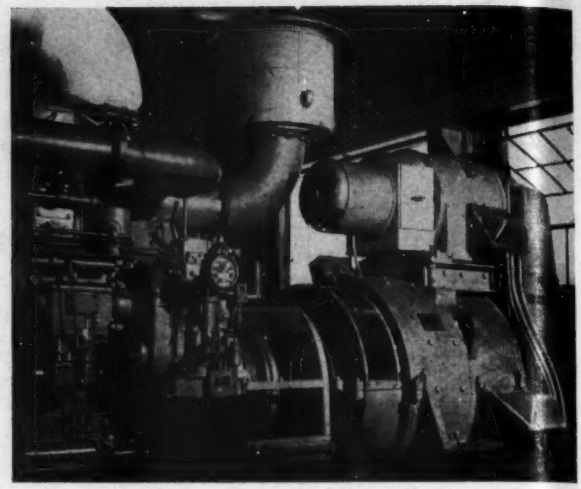
Speed control of the motors with minimum electrical losses is obtained through the use of the Ward Leonard system of connecting the motors and generators. Under this system, the motor field is separately excited from the 60-kw., constant-voltage generator and the armature is connected directly to the 375-kw. generator armature. The speed and output of the motor can then be controlled by varying the field current of generator.

The excitation of the 375-kw. generator could be controlled by means of a variable resistance in the field circuit; however, the magnitude of the field current would necessitate the use of a rather bulky controller and considerable electrical loss would result. In order to reduce the size of the control equipment and avoid excessive electrical losses, the generator field current is furnished by a specially designed motor-driven exciter which also furnishes current for the electro-hydraulic engine governor.



Below: Humble's diesel-electric rig, largest and most powerful of its kind, on location at Bayou Sale in Louisiana. House on superstructure has change room, tile bath, mud laboratory, office room. Left: Walkway and power barge. Walkway supports all power and control cables





Left: Inside view of power barge showing three 700-hp. 900-r.p.m. supercharged diesel engines direct connected to 375-kw. generator. Right: Portion of engine room, showing also 375-kw. generator with 60-kw. constant-voltage generator mounted on top

The output of this exciter is controlled by means of a small variable resistance or rheostat in the field circuit. The field current required by the exciter is very small, consequently the electrical loss in the rheostat is negligible.

During hoisting operations all three generators can be connected to the draw-works motor; however, during ordinary drilling operations, one generator is connected to the pump motor, one to the draw-works motor and one to the rotary motor. The 60-kw. constant-voltage generators furnish current for the operation of the mud-mixing pump, shale shaker, blower, and other auxiliaries.

The power barge is equipped with a 5-ton, hand-operated traveling crane for handling equipment. Other equipment on this barge consists of auxiliary switchboard, a 9-kw. diesel generator unit for lights when the large engines are shut down, two motor-driven air compressors, and a small boiler for heating purposes. Equipment such as heat exchangers, raw-water pumps, air receivers, oil tanks, fresh-water pump, and motor-driven exciters are mounted below deck.

A superstructure 14 ft. high extends 82 ft. from the afterend of each hull of the drilling barge. This supports the derrick, draw works, and rotary, and also provides a means of fastening the two hulls together. When necessary to transport the drilling barge through narrow waterways, the hulls can be separated by removing the tie members between the superstructure.

Mounted on the superstructure is a 136-ft.-high by 30-ft.-base derrick of conventional design, except that provision has been made for the use of hydraulic jacks and shims for leveling the derrick when the barges settle unevenly. The draw works are a conventional four-speed type, equipped with air brakes and driven by a mill-type electric motor. This motor is rated at 1,000 hp. at 725 r.p.m. for continuous duty, but will deliver approximately 1,700 hp. for intermittent duty such as hoisting drill pipe. The rotary is independently driven by a 300-hp., mill-type motor direct connected to the pinion shaft with a flexible coupling. One-half of the coupling is equipped with a sprocket so that a chain drive from the draw works can be used if necessary. The torque output of the rotary motor is directly proportional to the armature current and the speed is proportional to the armature voltage. An ammeter and voltmeter calibrated in pound-foot torque and revolutions per minute, respectively, are mounted in view of the driller. Also mounted on the derrick floor is a coring reel driven by a 300-hp. motor. This reel has a capacity of 18,000 ft. of ⅝-in. wire rope.

A stiff-leg derrick or cargo hoist with a capacity of 5 tons is mounted on each corner of the superstructure next to the pipe rack and is used for handling drill pipe, casing, and dry mud. The majority of loading and unloading is done from the port side of the drilling barge and the hoist on this side is operated by air motors. The starboard hoist is operated manually by means of hand winches. Also located on the superstructure is a house with a change room, tile bath, mud laboratory, office, bunk room, and dry-mud storage room. Equipment located in the central part of the housed section includes the main electrical switchboard, a diesel-electric auxiliary light plant, and the blower which furnishes air to the separately cooled motors.

On the forward end of the barges, on top of the reserve mud tanks, are pipe racks of sufficient length to accommodate A.P.I. range 3 casing. From the forward end of the pipe rack a hinged walkway extends 75 ft. to the power barge. This walkway provides a means of cummunication with the power barge and also supports all power and control cables.

The mud pumps are located on the afterdeck of the starboard barge with the active mud pits directly opposite on the port barge. Two 7¾ by 20-in. mud pumps, each driven by a 500-hp. mill-type motor, are used for drilling or circulating, and a 5 by 8-in. pump with a 60-hp. motor is used for mixing mud. The discharge and suction manifolds are arranged so that the large pumps may be compounded in series or parallel if necessary. Each of the large pumps is equipped with a precharged surge chamber designed by Humble. The surge chamber cushions the discharge surges characteristic of this type of pump and materially reduces vibration in the discharge manifold piping and whipping of the rotary-drilling hose. The suction manifold is connected to all hull compartments in the barges as well as to the reserve mud tanks located on the forward deck of each barge. In case one of the desubmergence pumps should break down, this arrangement permits any compartment to be emptied by use of mud pumps.

The blowout preventers are operated by a 4 by 1¾ by 4-in. duplex pump driven by air. The electric, motor-driven air compressor and duplex pump, together with the regulating equipment and discharge manifold, are assembled on skids as a unit. The rotary slips are of the latest-designed, air-operated type which are controlled by a valve conveniently located near the driller's position. Other equipment, such as crown block, traveling block, and hook, is of the most modern design and of a size suitable for drilling 15,000 ft. and deeper.

Data for this article were supplied by the production department of Humble Oil & Refining Co.

Physical Constants

Of Low-Boiling Hydrocarbons And Miscellaneous Compounds

by W. S. Hanna and Robert Matteson**

THE past 10 years have seen the publication of several concise tables of physical constants designed mainly for engineering or ready-reference use by those interested in the hydrocarbons normally associated with natural gasoline, and in refining operations involving the lower-boiling constituents of crude oils. The first of such compilations showed either too few data or covered a large number of properties but left numerous gaps to be filled. It soon became evident, however, that the numerical values for several of the important constants did not agree in the various tables. Such a state of affairs indicated that it would be desirable to have an up-to-date standard source for the basic constants and that derived values would then be consistent in other tables.

One effect of the war, in so far as the field of physical properties is concerned, was the starting of A.P.I. Project 44 in 1942. On this project Dr. Rossini and his coworkers have assembled a vast amount of new data and critically evaluated much published and unpublished material. The tables issued by the project may be considered an A.P.I. standard and constitute an excellent standard source of basic data. They afford a bench mark, as it were, to which the main bulk of compilations such as those of the Natural Gasoline Association of America, Rubber Reserve, or C.N.G.A. can refer as a starting point. That tables used by all of these bodies, including A.P.I., should agree among themselves is obvious. In the table to be discussed, particular attention was paid to selecting as many constants as possible from A.P.I. Project 44 with full knowledge that even the data in the project's tables must be considered dynamic and not static. In other words, the values of the "constants" are variable.

To digress a moment, this variability of a physical "constant" can be illustrated by the published values for the boiling point for so common a substance as isobutane. In 1926 a value of 10° F. was published; 2 years later 13.6° F. was found for the boiling point; in 1934 it was given as 8.6° F. and in 1937, 13.6° F. Measurements and purification methods finally reached such a stage in 1940 that 10.87° F. was quoted as the correct boiling point at 760 mm., and finally, in 1945, A.P.I. Project 44 agreed on 10.89° F. as the best value to date. It might be added that all of the above-quoted figures are the results of careful work by fully qualified investigators. They simply show the typical course followed as the value for a particular physical constant becomes more and more refined. In many cases, it is true, the absolute values change but little and in an engineering sense it might be said yesterday's values were usually good enough, although, as shown in the case of the boiling point for isobutane, this certainly is not always true. In general, it can be said that the values for the basic physical constants (boiling point, freezing point, density, and refractive index) that were determined before about 1935 are open to suspicion and will bear checking.

Returning now to the compilation under discussion it should be noted in passing that this represents the fourth revision of the table originally begun in 1937. The 1940 version, which was revision No. 3, was presented before the C.N.G.A. by D. B. Johns, chairman of the physical constants committee. The new table is expanded to include more compounds than the 1940 version and it is felt the limit has just about been reached in this direction if the table is held to a size that will fit conveniently into an 8½ by 11-in. binder or that can be placed under the glass top of a desk.

Molecular Weights and Carbon Hydrogen Ratio

Considering the highlights of the table, it will be seen that the molecular weights have not been changed since revision No. 3 simply because the war put a stop to the work on research on atomic weights. At least the International Committee on Atomic Weights has issued no new values since 1941. The carbon-hydrogen ratio of the hydrocarbons is therefore the same as reported previously.

Melting Point, Boiling Point, Critical Data

Many important changes have been made in melting and boiling-point values as a result of the work on A.P.I. Project 44. In a great many instances the changes have been small indicating that we are now approaching very closely to the true values with refined preparative and measurement methods. Practically no new work has been done in the field of critical-temperature measurement of the light hydrocarbons since 1941 and so the present table contains only minor additions or revisions.

Density, Gas-Law Deviation Factor

In the columns of values for the various densities will be found the largest number of revisions in the new table in conformity with Project 44. One very important change was made in reporting specific gravity of the liquid at 60°/60° F. instead of using density at 60° F. It was found that the latter value caused considerable confusion because normally users of these tables are in the habit of thinking of the relation between specific gravity and A.P.I. gravity. Minor changes in gas densities have necessitated small revisions in the gas-law deviation factor at 60° F. and 1 atm. At this point it should be recalled that the gas-law deviation factor, "Y," as used here is the reciprocal of the compressibility factor, "z," often referred to in engineering work.

Specific Heat

Numerous changes in the heat-capacity data for the gases were made necessary in conformity with the A.P.I. values for specific heat at constant pressure. To simplify matters, all specific heats at constant volume

*California Research Corp., Richmond, Calif. A paper presented before a recent meeting of the California Natural Gasoline Association, Los Angeles.

and the ratios of specific heats were recalculated on a perfect-gas basis. The values for Cp were taken from Project 44 and Cv was calculated from the expression:

$$Cv = R - Cp$$

when R is the universal gas constant. The ratio of the specific heats was then simply:

$$\gamma = Cp/Cv = Cp/(R - Cp)$$

Specific heat of the liquid remains essentially the same as in 1941 since very few new data have appeared in the literature on this quantity.

In keeping with the practice followed in Project 44 all heats of combustion are now expressed on the basis of 77° F. (25° C.). The principal reason for changing from the 60° F. basis is that experiments are normally conducted at room temperature close to 75°-77° F. and thus the correction to the base temperature of 77° F. becomes extremely small. It is important to note, in this connection, that heat of combustion has come to be a standard specification on certain fuels, namely, aviation fuel, for use by government agencies and the base temperature of 77° F. is specified in such cases. Recent work at the National Bureau of Standards has greatly extended the list of pure hydrocarbons upon which we now have accurate heat-of-combustion data.

Heats of Vaporization and Fusion

Project 44 has published many new values for heats of vaporization and fusion. These have been adopted for inclusion in our table when changes in the values were indicated. Other revisions were adopted from values quoted in the recent literature as shown in the bibliography.

Air for Combustion, Inflammability Limits, Aniline Point, Etc.

Since the air required for combustion is calculated from the molecular

Physical Constants of the Light

No.	Compound	Formula	Molecular weight	Carbon/hydrogen ratio	Boiling point, °F., 760 mm.	Freezing point, °F., 760 mm.	Critical constants: Pressure, psi.	Critical constants: Temperature, °F.	Liquid density, 60° F., 760 mm.: Specific gravity, 60/60° F.	Liquid density, 60° F., 760 mm.: °A.P.I.	Liquid density, 60° F., 760 mm.: Lb./gal.	Liquid density, 60° F., 760 mm.: Lb. mols per 100 gal.	Gas density, 60° F., 760 mm. perfect gas: Specific gravity, Air = 1	Gas density, 60° F., 760 mm. perfect gas: Lb. per 1,000 cu. ft.	Gas density, 60° F., 760 mm. perfect gas: Cu. ft. gas per gallon liquid	Gas density, 60° F., 760 mm. perfect gas: Unit vol. of gas/unit vol. liquid	Cu. ft. gas per gallon liquid (actual)	Derivation factor Y = RT/PV	Specific heat, 760 mm., 60° F.: Gas: Cp	Gas: Cv	Gas: Cp/Cv	Cp liquid
	Paraffin series C_nH_{2n+2}																					
1	Methane	CH_4	16.042	3.99	—258.66	—296.46	673	—116.3	†0.348	....	....	....	0.5539	42.27	....	....	....	1.002	0.5328	0.4019	1.326	....
2	Ethane	C_2H_6	30.068	3.97	—127.51	—297.91	709	+90.1	†0.377	....	....	....	1.0380	79.23	....	....	....	1.003	.4802	.3431	1.193	0.70
3	Propane	C_3H_8	44.094	4.47	—43.73	—305.77	618	+206.3	°.5077	147.2	4.223	0.577	1.5223	116.19	30.35	271.0	35.70	1.016	.3975	.3434	1.122	.534 at —40° F.
4	n-Butane	C_4H_{10}	58.120	4.77	31.10	—216.90	551	305.6	°.5844	110.6	4.863	0.387	2.0065	153.15	21.75	237.5	26.77	1.022	.3971	.3523	1.094	.548 at 0° F.
5	Isobutane	C_4H_{10}	58.120	4.77	10.89	—255.30	530	273.2	°.5631	119.8	4.695	0.961	2.0065	153.15	20.39	223.0	28.70	1.020	.3865	.3623	1.067	.537 at +10° F.
6	n-Pentane	C_5H_{12}	72.146	4.96	96.93	—201.50	491	387.0	.6312	92.7	5.253	7.291	2.4907	190.11	27.83	305.7	30.30	1.048	.3974	.3690	1.075	.536 ∨
7	Isopentane	C_5H_{12}	72.146	4.96	82.14	—255.80	482	370.2	.6248	93.6	5.199	7.206	2.4907	190.11	27.85	304.6	28.17	1.045	.3980	.3665	1.076	.533
8	2,2-Dimethylpropane	C_5H_{12}	72.146	4.96	49.10	+2.1	465	353.2	°.596	108.1	4.960	6.903	2.4907	190.11	29.20	320.0	....	....	.3910	.3635	1.076	....
9	n-Hexane	C_6H_{14}	86.172	5.11	156.74	—139.58	434	454.6	.6641	81.8	5.537	6.414	2.9749	227.07	24.34	183.1	22.23	1.063	.3994	.3733	1.062	.532
10	2,2-Dimethylbutane	C_6H_{14}	86.172	5.11	121.54	—147.51	441	422.4	.6540	84.8	5.443	6.316	2.9749	227.07	23.97	179.5	....	....	.395	.368	1.084	.495
11	2,3-Dimethylbutane	C_6H_{14}	86.172	5.11	136.36	—199.34	451	440.8	.6684	80.8	5.547	6.437	2.9749	227.07	24.43	182.8	....	....	.395	.372	1.062	.504
12	2-Methylpentane	C_6H_{14}	86.172	5.11	140.49	—244.63	....	442.4	.6579	82.5	5.475	6.354	2.9749	227.07	24.11	180.4	....	....	.400	.377	1.061	.543
13	3-Methylpentane	C_6H_{14}	86.172	5.11	145.91	—100	453	448.6	.6690	80.6	5.568	6.461	2.9749	227.07	24.52	183.4	....	....	.400	.377	1.061	.511
14	n-Heptane	C_7H_{16}	100.198	5.21	209.17	—131.07	397	512.6	.6881	74.1	5.728	5.717	3.4591	264.03	21.69	162.3	19.85	1.087	.3993	.3794	1.052	.511
15	2,2,3-Trimethylbutane	C_7H_{16}	100.198	5.21	177.57	—12.93	427	496.8	.6943	72.2	5.781	5.770	3.4591	264.03	21.90	163.8	....	....	.399	.379	1.053	.491
16	n-Octane	C_8H_{18}	114.224	5.20	258.36	—70.34	370	564.0	.7069	68.7	5.884	5.151	3.9434	300.90	19.35	148.3	17.77	1.100	.3990	.3824	1.043	.510
17	2,2,3-Trimethylpentane	C_8H_{18}	114.224	5.20	229.72	—170.09	....	543.0	.7235	64.9	5.996	5.249	3.9434	300.90	19.92	149.0	....	....	.39	.373	1.046	....
18	2,2,4-Trimethylpentane	C_8H_{18}	114.224	5.20	210.63	—161.26	372	520.2	.6963	71.7	5.796	5.074	3.9434	300.90	19.35	144.1	....	....	.39	.373	1.046	.493
19	2,3,3-Trimethylpentane	C_8H_{18}	114.224	5.20	238.37	—149.36	....	554.4	.7304	62.2	6.080	5.323	3.9434	300.90	20.20	151.1	....	....	.39	.373	1.046	....
20	2,3,4-Trimethylpentane	C_8H_{18}	114.224	5.20	236.25	—184.98	....	549.3	.7233	64.1	6.021	5.271	3.9434	300.90	20.00	149.6	....	....	.39	.363	1.047	.506
21	n-Nonane	C_9H_{20}	128.250	5.26	303.44	—64.49	335	613.0	.7218	64.5	6.009	4.685	4.4276	337.95	17.76	133.0	15.88	1.130	.400	.385	1.040	.517
22	n-Decane	$C_{10}H_{22}$	142.276	5.42	345.3	—21.42	312	651.3	.734	61.3	6.119	4.294	4.9119	374.91	16.30	121.9	14.50	1.146	.401	.387	1.036	.517
	Olefin series C_nH_{2n}																					
23	Ethene	C_2H_4	28.052	6.86	—154.66	—272.47	742	48.5	....	....	....	....	0.9685	73.92	....	....	....	1.0057	.361	0.290	1.245	....
24	Propene	C_3H_6	42.078	6.86	—53.86	—301.45	668	196.5	°.5218	136.7	4.341	10.317	1.4527	110.90	38.15	292.9	36.53	1.0153	.361	.314	1.150	....
25	1-Butene	C_4H_8	56.104	6.86	20.79	—301.65	610	291.2	°.6011	103.3	5.002	6.916	1.9369	147.84	33.83	259.1	31.78	1.0222	.360	.333	1.105	.537
26	cis-2-Butene	C_4H_8	56.104	6.86	38.70	—218.04	....	311.0	°.6272	94.1	5.220	6.304	1.9369	147.84	35.31	264.3	34.08	1.016	.332	.297	1.116	....
27	trans-2-Butene	C_4H_8	56.104	6.86	33.58	—157.99	....	311.0	°.6190	100.5	5.078	6.047	1.9369	147.84	34.33	258.3	33.14	1.016	.362	.327	1.107	.535
28	Isobutene	C_4H_8	56.104	6.86	19.58	—220.65	580	292.5	°.6002	104.3	4.995	6.903	1.9369	147.84	33.79	253.2	....	1.0024	.372	.327	1.139	....
29	1-Pentene	C_5H_{10}	70.130	6.94	85.95	—301.49	595	366.3	.6451	87.5	5.377	7.557	2.4211	184.80	29.16	217.7	26.35	1.030	.360	.312	1.09	.532 at +32° F.
30	cis-2-Pentene	C_5H_{10}	70.130	6.94	98.8	....	....	....	.651	82.8	5.502	7.845	2.4211	184.80	29.77	222.7	....	....	.340	.320	1.063	....
31	trans-2-Pentene	C_5H_{10}	70.130	6.94	97.43	—220.63	....	....	.6503	83.1	5.437	7.753	2.4211	184.80	29.42	220.1	....	....	.372	.344	1.081	....
32	2-Methyl-1-Butene	C_5H_{10}	70.130	6.94	87.88	—215.61	....	....	.6527	84.3	5.458	7.783	2.4211	184.80	29.52	220.8	....	....	....	....	....	....
33	3-Methyl-1-Butene	C_5H_{10}	70.130	6.94	68.11	—271.30	498	376.9	.6332	92.2	5.294	7.550	2.4211	184.80	29.46	213.1	....	....	.360	.320	1.075	....
34	2-Methyl-2-Butene	C_5H_{10}	70.130	6.94	101.94	—209.8	513	376.9	.6976	80.5	5.507	7.734	2.4211	184.80	30.07	223.5	....	....	....	....	....	.500
35	1-Hexene	C_6H_{12}	84.156	6.90	148.30	—218	....	470.3	.6761	77.2	5.644	6.707	2.9054	221.76	23.45	169.4	....	....	.38	.338	1.071	.493
36	1-Heptene	C_7H_{14}	98.182	6.90	199.9	—182.6	....	....	.7019	70.5	5.857	5.945	3.3898	258.72	22.36	169.8	....	....	....	....	....	.511
37	1-Octene	C_8H_{16}	112.208	6.86	250.29	—152.3	....	589.2	.7204	64.9	5.997	5.346	3.8733	295.68	20.38	151.7	....	....	....	....	....	.485
38	1-Nonene	C_9H_{18}	126.234	6.86	301.8	—126.4	....	....	.735	61.0	6.119	4.847	4.3560	332.64	18.40	137.7	....	....	....	....	....	....
39	1-Decene	$C_{10}H_{20}$	140.260	6.86	341.6	—87.3	....	....	.748	57.7	6.227	4.440	4.8423	369.60	16.85	126.1	....	....	....	....	....	....
	Aromatic series C_nH_{2n-6}																					
40	Benzene	C_6H_6	78.108	11.01	176.18	+41.86	708	551.3	0.8840	28.5	7.360	9.431	2.6965	205.81	35.79	307.7	34.75	1.00	0.2494	....	....	0.4078
41	Toluene	C_7H_8	92.134	10.43	231.13	—138.86	611	609.1	.8719	30.3	7.259	7.880	3.1807	242.76	29.30	223.7	28.76	1.04	.2399	....	....	.4014
42	o-Xylene	C_8H_{10}	106.160	9.93	291.96	—13.34	542	674.9	.8847	28.4	7.367	6.940	3.6650	279.74	26.34	197.6	25.00	1.06	.235	....	....	.418
43	m-Xylene	C_8H_{10}	106.160	9.93	282.39	—54.17	536	654.1	.8688	31.4	7.234	6.814	3.6650	279.74	25.86	193.5	24.53	1.05	.232	....	....	.405
44	p-Xylene	C_8H_{10}	106.160	9.93	281.05	+55.87	515	651.4	.8657	32.0	7.209	6.791	3.6650	279.74	25.77	192.8	24.54	1.05	.270	....	....	.408
	Additional compounds																					
45	Acetylene	C_2H_2	26.036	11.01	—119	—154	911	188.5	....	....	....	....	0.8969	68.61	....	....	....	1.003	0.3985	0.3331	1.339	....
46	Cyclopentane	C_5H_{10}	70.130	5.86	+120.65	—136.84	746	487.6	0.7505	57.0	6.248	8.909	2.4211	184.80	30.61	263.9	....	....	....	....	....	.432
47	Methylcyclopentane	C_6H_{12}	84.156	5.86	161.27	—224.49	....	....	.7535	56.3	6.273	7.454	2.9054	221.76	29.39	211.6	27.30	1.040	....	....	....	.44
48	Cyclohexane	C_6H_{12}	84.156	5.86	177.39	+43.80	594	540	.7834	49.1	6.522	7.750	2.9054	221.76	29.41	210.9	28.23	1.036	....	....	....	....
49	Acetone	C_3H_6O	58.078	....	133.7	139.3	691	455	.798	45.3	6.627	11.411	2.0052	153.04	43.30	323.9	....	....	.31	....	1.37	.313
50	Diethylether	$C_4H_{10}O$	74.120	....	94.3	—177.3	523	391	.719	65.3	5.985	6.275	2.5568	195.31	36.64	216.2	....	....	.344	....	....	.525
51	Phenol	C_6H_5OH	94.108	....	359.0	+106	....	....	....	....	....	....	3.2499	247.99	....	....	....	....	....	....	....	.5 at 113° F.
	Diesel standards																					
52	Cetene	$C_{16}H_{34}$	226.435	5.62	547.7	64.4	232	661	.777	50.6	6.469	2.857	7.8172	596.67	19.04	91.1	....	....	....	....	....	0.495
53	Cetene	$C_{16}H_{34}$	226.435	5.86	555	39.5	....	....	.7988	46.3	6.556	2.918	7.7475	591.54	11.86	92.8	....	....	....	....	....	.472
54	Alpha-Methylnaphthalene	$C_{11}H_{10}$	142.190	10.11	472.8	—22.5	....	....	1.022	6.2	8.520	5.991	4.9060	374.60	22.74	171.1	....	....	....	....	....	....
	Alcohols																					
55	Methyl alcohol	CH_3OH	32.042	....	148.1	—143.9	1,157	464	.7963	46.3	6.630	20.692	1.1091	84.63	79.53	607.5	75.00	1.02	0.27	0.446	1.203	0.572
56	Ethyl alcohol	C_2H_5OH	46.068	....	172.9	—174.1	927	469.4	.7946	46.7	6.611	14.361	1.5894	121.30	54.46	407.4	53.30	1.02	.307	.366	1.15	.555
	Miscellaneous																					
57	Carbon	C	12.01	....	....	+6300	....	....	(‡)	....	....	....	....	....	....	....	....	....	0.1643	....	....	....
58	Hydrogen	H_2	2.016	....	—423.0	—434.4	188	—399.8	0.071	....	....	....	0.0696	5.313	....	....	....	0.9983	3.409	2.42	1.41	....
59	Oxygen	O_2	32.000	....	—297.4	—361.1	736	—181.8	1.140	....	....	....	1.1047	84.323	....	....	....	1.00075	0.2186	0.156	1.401	....
60	Nitrogen	N_2	28.016	....	—320.4	—346.0	492	—232.9	.800	....	....	....	0.9671	73.834	....	....	....	1.0003	0.2491	0.177	1.404	....
61	Carbon monoxide	CO	28.010	....	—313.7	—337.0	514	—218.5	.801	....	....	....	.9670	73.81	....	....	....	1.0013	.2484	.177	1.404	....
62	Carbon dioxide	CO_2	44.010	....	—109.3	.....	1,073	+88	1.05 (solid)	..	....	....	1.5194	115.97	....	....	....	1.0050	.1991	.158	1.26	....
63	Hydrogen sulfide	H_2S	34.076	....	—76.5	—121.9	1,306	212.7	.790	....	....	....	1.1764	89.79	....	....	....	1.0119	.254	.193	1.32	....
64	Sulfur dioxide	SO_2	64.060	....	+14.0	—90.9	1,142	315	1.460	....	....	....	2.2115	168.80	....	....	....	1.0166	.147	.118	1.24	....
65	Water	H_2O	18.016	....	+212.0	+32	3,206	705.4	1.000	10.0	8.330	66.256	.6220	47.47	170.44	1312.5	170.70	1.0065	.4446	.332	1.333	1.000
66	Air	....	28.960	....	—317.7	.....	547	—221.3	.856	....	....	....	1.0000	76.330	....	....	....	1.00000	.241	.171	1.410	....

*At saturation pressure. †Methane and ethane are "apparent" sp. gr. at 60° F. ‡Densities at S.T. except for water.

weights there is no need for revising the 1941 values. No new work has appeared on inflammability limits nor aniline point, thus these values remain the same as in our previous table. The refractive index values, however, were extensively revised in accordance with the new Project 44 values.

Octane Number

Octane numbers have been revised in line with the new data from A.P.I. Project 45 (formerly the Ohio State Hydrocarbon Project). It will be noted that on the new table certain octane numbers above 100 are shown as isooctane plus a number of milliliters of tetraethyl lead. On the other hand, methane, ethane, ethene, propene, and the xylenes are shown as having octane numbers of simply 100+ since the equivalents in ml. of "lead" in isooctane are unknown.

Now it may be asked if revision of tables such as the one described here is necessary as often as once every 3 or 4 years. The answer is that 10 or 15 years ago it was impossible to make up such a table without including many blank spaces or, at best, many values of questionable validity. With time, and particularly with the advent of Project 44, the number of gaps has been reduced and the reliability of the data increased. To keep up with the rapid changes in the field, it has been imperative to make frequent revisions so that the users of the tables could be supplied with the most recent and reliable values for the physical constants.

Throughout the discussion emphasis has been laid upon the support gained from A.P.I. Project 44. Actually, 91 sources of data were drawn upon for the values of the constants selected in the table. However, the desirability of having this compilation in complete agreement with the A.P.I. tables needs no elucidation. A further prerequisite is to have concurrence

Hydrocarbons and Miscellaneous Compounds

No.	Compound—	Calorific value at 77° F. — (25° C.) B.t.u. per lb. vapor: Gross	Calorific value at 77° F. — (25° C.) B.t.u. per lb. vapor: Net	Calorific value at 77° F. — (25° C.) B.t.u. per cu. ft. vapor (°) means 60° F. and 760 mm.: Gross	Calorific value at 77° F. — (25° C.) B.t.u. per cu. ft. vapor (°) means 60° F. and 760 mm.: Net	Calorific value at 77° F. — (25° C.) B.t.u. per lb. liquid: Gross	Calorific value at 77° F. — (25° C.) B.t.u. per lb. liquid: Net	Calorific value at 77° F. — (25° C.) B.t.u. per gallon (°) means 60° F.: Gross	Calorific value at 77° F. — (25° C.) B.t.u. per gallon (°) means 60° F.: Net	Heat of vaporization at 760 mm. and B.P., B.t.u. per lb.	Heat of fusion at 760 mm., B.t.u. per lb.	Air required for combustion: Lb. per lb.	Air required for combustion: Cu. ft. per cu. ft.	Inflammability limits, vol. % in air mixture: Lower	Inflammability limits, vol. % in air mixture: Higher	Refractive index N_D^{20} (°) means 68° C. (*) means 15° C.	Aniline point, (°) means crit. soln. temp. (†) by Du Pont meth.	Octane No., (†) means on TEL in isooctane: Motor method	Octane No., (†) means on TEL in isooctane: Research method
	Paraffin series C_nH_{2n+2}																		
1	Methane	22,881	21,502	1,008.8	908.0	.....	.....	.....	.....	219.5	25.2	17.2	9.53	5.0	15.0	.....	....	110	100+
2	Ethane	22,304	20,416	1,767	1,618	.....	.....	.....	.....	210.3	40.9	16.06	16.67	3.22	12.45	.....	....	104	100+
3	Propane	21,646	19,939	2,515	2,316	21,490	19,774	90,752	83,596	183.05	34.4	15.65	23.62	2.37	9.50	.....	....	100	100+
4	n-Butane	21,293	19,685	3,261	3,012	21,104	19,506	101,774	94,038	165.04	34.3	15.43	30.27	1.86	8.41	.....	31.2	92	98
5	Isobutane	21,342	19,714	3,253	3,004	21,096	19,489	98,825	91,298	157.50	33.5	15.43	30.27	1.80	8.44	.....	225.7	99	100+
6	n-Pentane	21,072	19,489	4,006	3,707	20,914	19,348	109,861	101,593	153.59	38.1	15.30	38.11	1.40	7.28	1.35782	188.3	61.9	61.7
7	Isopentane	21,025	19,451	3,997	3,698	20,877	19,303	108,540	100,356	145.66	36.7	15.30	38.11	1.32	....	1.35973	208.3	90.3	92.3
8	2,2-Dimethylpropane	20,956	19,362	3,984	3,685	20,824	19,230	103,704	95,885	135.59	19.4	15.30	38.11	....	....	.....	....	....	89.8
9	n-Hexane	20,959	19,391	4,753	4,402	20,771	19,233	114,891	106,391	144.77	64.9	15.21	45.26	1.25	6.96	1.37486	156.5	24.9	24.8
10	2,2-Dimethylbutane	20,837	19,289	4,731	4,382	20,698	19,151	112,859	104,525	132.86	2.3	15.21	45.26	....	....	1.36976	*176.1	91.4	91.8
11	2,3-Dimethylbutane	20,876	19,328	4,740	4,391	20,739	19,192	114,899	106,450	137.67	2.3	15.21	45.26	....	....	1.37485	*181.6	94.8	†.22
12	2-Methylpentane	20,893	19,356	4,745	4,395	20,743	19,206	113,568	105,153	136.32	31.3	15.21	45.26	....	....	1.37145	*168.0	73.5	73.4
13	3-Methylpentane	20,938	19,389	4,747	4,398	20,755	19,218	113,564	107,206	141.07	....	15.21	45.26	....	....	1.37602	*180.0	74.3	74.5
14	n-Heptane	20,825	19,314	5,488	5,090	20,660	19,157	118,998	109,721	137.32	60.3	15.15	52.41	1.09	6.0	1.38764	159.1	0	0
15	2,2,3-Trimethylbutane	20,752	19,241	5,479	5,080	20,614	19,104	119,170	110,440	134.8	9.4	15.15	52.41	....	....	1.38048	*161.0	†0.07	†1.59
16	n-Octane	20,747	19,236	6,245	5,798	20,591	19,100	121,157	112,304	131.85	77.7	15.10	59.55	0.95	....	1.39741	181.1	....	....
17	2,2,3-Trimethylpentane	20,703	19,212	6,231	5,782	20,564	19,073	122,302	114,363	121.1	....	15.10	59.55	....	....	1.40295	*189.4	99.8	†1.16
18	2,2,4-Trimethylpentane	20,660	19,187	6,227	5,771	20,550	19,063	119,143	110,501	119.59	94.7	15.10	59.55	....	....	1.39146	*179.8	100	100
19	2,3,3-Trimethylpentane	20,717	19,226	6,236	5,767	20,577	19,086	121,108	112,049	122.5	....	15.10	59.55	....	....	1.40732	*182.6	99.4	†.81
20	2,3,4-Trimethylpentane	20,713	19,222	6,234	5,768	20,572	19,080	123,894	114,690	122.99	....	15.10	59.55	....	....	1.40422	*184.0	93.9	†.22
21	n-Nonane	20,667	19,211	6,991	6,492	20,531	19,056	123,250	114,486	125.85	74.0	15.06	66.70	0.83	....	1.40549	195.1	....	....
22	n-Decane	20,650	19,175	7,737	7,189	20,483	19,020	125,151	116,312	122	87.2	15.04	73.85	0.87	....	1.4120	171.5	....	....
	Olefin series C_nH_{2n}																		
23	Ethene	21,635	20,276	1,589	1,489	.....	.....	.....	... ..	207.36	51.3	14.79	14.29	2.75	28.60	.....	....	81	100+
24	Propene	21,032	19,683	2,332	2,182	20,887	19,538	90,670	84,814	188.32	30.7	14.79	21.44	2.0	11.10	.....	....	85	100+
25	1-Butene	20,833	19,484	3,089	2,891	20,674	19,325	103,411	96,664	167.95	29.5	14.79	28.58	1.70	9.00	.....	....	99	....
26	cis-2-Butene	20,780	19,431	3,072	2,873	20,610	19,261	107,594	100,562	179.91	58.1	14.79	28.58	....	....	.....	....	....	....
27	trans-2-Butene	20,747	19,397	3,067	2,868	20,580	19,230	104,454	97,611	174.37	74.8	14.79	28.58	....	....	.....	....	....	....
28	Isobutene	20,716	19,367	3,063	2,863	20,552	19,213	102,707	95,990	169.47	45.5	14.79	28.58	....	....	.....	38.0	97	....
29	1-Pentene	20,896	19,346	3,833	3,575	20,742	19,192	110,454	102,195	148	30.9	14.79	35.73	1.60	....	1.3714	....	77.1	90.8
30	cis-2-Pentene	20,657	19,308	3,817	3,566	.....	.....	.....	.....	.....	....	14.79	35.73	....	....	1.3930	54.6	....	....
31	trans-2-Pentene	20,629	19,280	3,812	3,563	.....	.....	.....	.....	.....	....	14.79	35.73	....	....	1.3793	54.6	....	....
32	2-Methyl-1-Butene	20,601	19,253	3,807	3,558	.....	.....	.....	.....	.....	....	14.79	35.73	....	....	1.3779	....	....	....
33	3-Methyl-1-Butene	20,646	19,297	3,815	3,566	.....	.....	.....	.....	.....	....	14.79	35.73	....	....	†1.3843	....	....	....
34	2-Methyl-2-Butene	20,563	19,214	3,800	3,551	20,394	19,054	113,272	105,777	160	....	14.79	35.73	....	....	1.3874	....	84.7	97.3
35	1-Hexene	20,611	19,261	4,571	4,272	19,649	19,100	109,779	107,000	149	....	14.79	42.88	....	....	1.3978	73.8	....	80
36	1-Heptene	20,551	19,202	5,317	4,968	20,387	19,038	118,999	111,125	140	58.3	14.78	50.02	....	....	1.3994	61.0	....	54
37	1-Octene	20,506	19,157	6,063	5,664	20,342	19,025	121,159	114,083	129	....	14.78	57.17	....	....	1.4068	*90.5	84.7	89.7
38	1-Nonene	20,471	19,122	6,809	6,361	.....	.....	.....	.....	.....	....	14.78	64.32	....	.....	1.4151	108.4	....	99
39	1-Decene	20,443	19,094	7,555	7,057	.....	.....	.....	.....	.....	....	14.78	71.46	....	....	1.4235	*111.4	....	....
	Aromatic series C_nH_{2n-6}																		
40	Benzene	18,172	17,446	3,743	3,591	17,886	17,230	121,485	116,610	169.5	54.1	13.25	35.70	1.41	6.75	1.50110	†—135	†2.75	....
41	Toluene	18,422	17,681	4,472	4,275	18,545	17,424	132,440	126,486	156.3	30.9	13.25	42.89	1.27	6.75	1.49691	†—135	†0.57	†3.88
42	o-Xylene	18,514	17,725	5,207	4,959	18,638	17,547	135,810	129,250	149.1	55.1	13.05	50.02	1.0	6.0	1.50323	†—135	100	100+
43	m-Xylene	18,507	17,718	5,200	4,955	18,634	17,543	133,350	126,910	147.4	48.9	13.05	50.02	....	....	1.49715	†—135	100+	100+
44	p-Xylene	18,518	17,719	5,204	4,957	18,639	17,547	13,290	126,480	148.1	99.3	13.05	50.02	....	....	1.49500	†—135	100+	100+
	Additional compounds																		
45	Acetylene	21,480	20,730	1,472	1,422	.....	.....	.....	.....	258	....	13.25	11.91	2.5	80	.....	....	....	....
46	Cyclopentane	20,350	19,001	3,761	3,511	20,175	18,825	126,993	117,519	167.5	38.9	14.78	35.7	....	....	1.40642	69.3	85	....
47	Methylcyclopentane	20,270	18,930	4,497	4,136	20,117	18,782	129,194	117,732	149.8	36.1	14.78	42.89	....	....	1.40970	99.3	90	91.3
48	Cyclohexane	20,195	18,848	4,478	4,179	20,088	18,676	130,810	121,986	153.9	13.3	14.78	42.89	1.33	8.35	1.42923	96.7	77.2	83.0
49	Acetone	13,482	12,800	2,063	1,914	13,342	12,671	87,808	81,332	235	42.2	9.51	33.59	....	....	1.35911	....	....	....
50	Diethylether	.....	.....	.....	.....	15,816	14,620	94,855	86,936	150	....	11.17	50.03	....	....	1.3526	....	....	....
51	Phenol	.....	.....	.....	.....	*14,086	*13,580	.....	.....	193	52.2	10.27	53.35	....	....	.....	....	....	....
	Diesel standards																		
52	Cetane	.....	.....	.....	.....	20,310	19,090	131,355	122,190	76	112	14.93	110.72	....	....	1.4347	209.2	....	....
53	Cetene	.....	.....	.....	.....	20,310	19,000	133,071	124,226	.....	....	14.79	114.34	....	....	1.4417	162.3	....	....
54	Alpha-Methylnaphthalene	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	13.19	94.32	....	....	*1.61494	....	....	....
	Alcohols																		
55	Methyl alcohol	10,250	9,040	865	763	9,720	8,570	64,643	56,819	473	43.7	6.45	7.15	6.72	36.5	1.3288	....	....	....
56	Ethyl alcohol	12,150	11,018	1,356	1,447	12,795	11,523	84,311	76,167	361	46.4	9.00	14.30	3.33	19.05	1.3614	....	92.3	....
	Miscellaneous																		
57	Carbon	*14,087	.....	....	....	.....	.....	.....	.....	.....	....	....	....	....	....	.....	....	....	....
58	Hydrogen	60,958	51,571	324	274	.....	.....	.....	.....	194	27.3	34.29	2.86	4.0	74.2	.....	....	....	....
59	Oxygen	.....	.....	....	....	.....	.....	.....	.....	92	5.9	....	....	....	....	.....	....	....	....
60	Nitrogen	.....	.....	....	....	.....	.....	.....	.....	86	11.9	....	....	....	....	.....	....	....	....
61	Carbon monoxide	4,344	.....	321	....	.....	.....	.....	... ..	91	14.4	34.83	2.86	12.5	74.2	.....	....	....	....
62	Carbon dioxide	.....	.....	....	....	.....	.....	.....	.....	.....	81.5	....	....	....	....	.....	....	....	....
63	Hydrogen sulfide	7,496	6,893	....	....	.....	.....	.....	.....	239	30	5.67	7.15	4.3	46.5	.....	....	....	....
64	Sulfur dioxide	.....	.....	....	....	.....	.....	.....	.....	169	55	....	....	....	....	.....	....	....	....
65	Water	.....	.....	....	....	.....	.....	.....	.....	970	143	....	....	....	....	1.3330	....	....	....
66	Air	.. .	.....	....	....	.....	.....	.....	.....	92	....	....	....	....	....	.....	....	....	....

between this newest table and those in use or proposed by the Natural Gasoline Association of America, the Rubber Reserve, and the A.S.T.M. Adoption of all or parts of this table by C.N.G.A. will have the desired effect of circulating to the members of the association values that are accepted by the major standardizing bodies of the nation.

An invaluable aid in preparing the new table has been the constructive criticism of our coworkers in the California Research Corp. laboratories, from members of the C.N.G.A., and other bodies interested in this type of standardization. It is our hope that suggestions and criticisms will continue to come in to keep our tables dynamic rather than static.

(Continued on page 67)

BIBLIOGRAPHY REFERENCE NUMBERS

								Specific heat					Calorific value					Octane No.	
	Paraffin series C_nH_{2n+2}	Melting point	Boiling point	Critical pressure	Critical temp.	Specific gravity liquid	Gas law deviation factor	Cp	Cv	Cp/Cv	Cp liquid	Heat of fusion	Heat of vaporization	Gaseous	Liquid	Inflammable limits	Refractive index	Aniline point	Motor method	Research method
1	Methane	1	1	6	46	33	65	1	8	8	..	1	1	1	..	56	..	..	6	6
2	Ethane	1	1	68	72	33	84	1	8	8	46	1	1	1	..	56	..	..	6	6
3	Propane	1	1	73	73	1	85-77	1	8	8	50	1	1	1	1	56	..	..	6	6
4	n-Butane	1	1	42	42	1	86	1	8	8	45	1	1	1	1	56	..	57	6	6
5	Isobutane	1	1	45	45	1	87	1	8	8	49	1	1	1	1	56	..	57	6	6
6	n-Pentane	1	1	74	74	1	88	1	8	8	19	1	1	1	1	56	1	57	83	83
7	Isopentane	1	1	74	74	1	87	1	8	8	48	1	1	1	1	56	1	62	83	83
8	2,2-Dimethylpropane	1	1	6	6	22		1	8	8	..	1	1	1	1	..	..	..	..	83
9	n-Hexane	1	1	24	23	1	87	1	8	8	11	1	1	1	1	56	1	57	83	83
10	2,2-Dimethylbutane	1	1	6	6	1	..	7	8	8	14	1	1	1	1	..	1	59	83	83
11	2,3-Dimethylbutane	1	1	74	75	1	..	7	8	8	14	1	1	1	1	..	1	59	83	83
12	2-Methylpentane	1	1	..	6	1	..	7	8	8	14	1	1	1	1	..	1	59	83	83
13	3-Methylpentane	1	1	76	6	1	..	7	8	8	14	..	1	1	1	..	1	59	83	83
14	n-Heptane	1	1	77	77	1	87	1	8	8	11	1	1	1	1	56	1	57	6	6
15	2,2,3-Trimethylbutane	1	1	6	6	1	..	1	8	8	13	1	1	1	1	..	1	..	..	83
16	n-Octane	1	1	6	23	1	66	1	8	8	11	1	1	1	1	56	1	57	6	..
17	2,2,3-Trimethylpentane	1	1	..	6	1	..	7	8	8	..	1	1	1	1	..	1	..	83	83
18	2,2,4-Trimethylpentane	1	1	6	6	1	..	7	8	8	15	1	1	1	1	..	1	59	83	83
19	2,3,3-Trimethylpentane	1	1	..	6	1	..	7	8	8	..	1	1	1	1	..	1	..	83	83
20	2,3,4-Trimethylpentane	1	1	..	6	1	..	7	8	8	12	1	1	1	1	..	1	..	83	83
21	n-Nonane	1	1	6	6	1	66	91	8	8	11	79	1	1	1	56	1	57	6	..
22	n-Decane	11	11	6	6	5	66	91	8	8	11	79	80	1	1	56	5	57	..	6
	Olefin series C_nH_{2n}																			
23	Ethene	1	1	23	23	..	89	1	8	8	..	1	1	1	..	56	..	..	6	6
24	Propene	1	1	78	78	1	89	1	8	8	..	1	1	1	21	56	..	..	6	6
25	1-Butene	1	1	6	4	1	89	1	8	8	16	1	1	1	21	56	..	..	6	..
26	cis-2-Butene	1	1	..	4	1	89	1	8	8	..	1	1	1	..	..	..	..	..	..
27	trans-2-Butene	1	1	..	4	1	89	1	8	8	16	1	1	1	..	..	..	..	..	..
28	Isobutene	1	1	6	6	1	89	1	8	8	..	1	1	1	..	..	..	..	6	..
29	1-Pentene	1	1	6	4	1	..	1	8	8	10	79	23	1	21	56	1	62	..	83
30	cis-2-Pentene	1	1	..	..	1	..	1	8	8	..	..	..	1	..	..	1	..	..	..
31	trans-2-Pentene	1	1	..	..	1	..	1	8	8	..	..	..	1	..	..	1	..	..	..
32	2-Methyl-1-Butene	1	1	..	..	1	..	..	..	..	..	..	..	1	..	..	1	..	..	..
33	3-Methyl-1-Butene	1	1	6	6	1	..	1	8	8	..	..	..	1	..	..	1	..	..	..
34	2-Methyl-2-Butene	1	1	6	6	1	..	..	..	..	19	..	47	1	..	..	1	..	..	6
35	1-Hexene	1	1	..	6	1	..	1	8	8	18	..	81	1	21	..	1	6	..	6
36	1-Heptene	1	1	..	..	1	..	..	..	..	18	18	4	1	21	..	1	6	..	6
37	1-Octene	1	1	..	6	1	..	..	..	..	17	..	4	1	21	..	1	6	83	83
38	1-Nonene	6	23	..	..	22	..	..	..	..	..	..	..	..	..	..	4	6	..	6
39	1-Decene	6	6	..	..	22	..	..	..	..	..	..	..	..	..	..	4	6	..	..
	Aromatic series C_nH_{2n-6}																			
40	Benzene	1	1	23	23	1	17	1	..	..	35	1	1	1	1	71	1	63	83	..
41	Toluene	1	1	23	23	1	17	1	..	..	35	1	1	1	1	71	1	63	83	83
42	o-Xylene	1	1	6	6	1	17	1	..	..	34	34	1	1	1	71	1	63	6	6
43	m-Xylene	1	1	6	6	1	17	1	..	..	34	34	1	1	1	..	1	63	6	6
44	p-Xylene	1	1	6	6	1	17	1	..	..	34	34	1	1	1	..	1	63	6	6
	Additional compounds																			
45	Acetylene	1	1	23	45	..	..	1	8	67	..	..	6	1	..	71	..	..	..	..
46	Cyclopentane	1	1	24	24	1	..	..	..	..	35	24	1	1	1	..	1	62	83	..
47	Methylcyclopentane	1	1	..	..	1	17	..	..	..	35	10	1	1	1	..	1	62	83	83
48	Cyclohexane	1	1	23	23	1	17	..	..	..	44	25	1	1	1	71	1	..	83	83
49	Acetone	10	10	10	23	5	..	38	..	30	82-58-40	10	10	27	27	..	11	..	..	..
50	Diethylether	28	28	10	10	5	..	38	..	..	39	..	10	..	28	..	11-10	..	..	..
51	Phenol	5	5	..	..	..	..	..	..	..	9	10	9	..	23	..	..	..	..	..
	Diesel standards																			
52	Cetane	6	6	6	6	6	..	..	..	..	..	4	6	..	6	..	11	..	..	6
53	Cetene	22	23	..	..	31	..	..	..	..	..	..	..	..	6	..	31	..	..	6
54	Alpha-Methylnaphthalene	6	6	..	..	6	..	..	..	..	..	..	..	..	..	..	6	..	..	..
	Alcohols																			
55	Methyl alcohol	5	5	23	23	5	17	29	..	10	4	60	23	3	3	71	10	..	..	..
56	Ethyl alcohol	5	5	23	23	5	17	29	..	10	4	61	23	3	3	71	5	..	63	..
	Miscellaneous																			
57	Carbon	23	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	..	..	..
58	Hydrogen	23	23	23	23	23	17	1	4	4	..	23	17	1	..	71	..	..	..	..
59	Oxygen	23	23	23	23	23	87	1	4	4	..	23	17	..	..	..	..	..	..	..
60	Nitrogen	23	23	23	23	23	87	1	4	4	..	17	17	..	..	..	..	..	..	..
61	Carbon monoxide	17	45	23	23	23	17	1	4	4	..	23	17	1	..	71	..	..	..	..
62	Carbon dioxide	..	23	23	23	23	87	1	54	1-54	..	23	..	..	..	..	..	..	..	..
63	Hydrogen sulfide	37	37	23	23	64	87	51	..	4	..	70	70	4	..	71	..	..	..	..
64	Sulfur dioxide	23	23	45	45	23	17	55	55-52	52	..	90	90	..	..	..	..	..	..	..
65	Water	23	23	43	43	23	17	1	4	4	4	23	23	..	..	..	10	..	..	..
66	Air	..	23	23	23	23	65	66	4	4	..	..	17	..	..	..	..	..	..	..

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Gas Development and Trends in South Texas

*by C. R. Williams**

THE estimated natural-gas reserves of the United States are approximately 150 trillion cubic feet, while the proven oil reserves are estimated to be in excess of 21 billion barrels. The Gulf Coast area now has proven gas reserves in excess of 45 trillion cubic feet. Of these reserves, the South Texas area alone has between 25 and 30 trillion cubic feet, and the State of Texas contains approximately 58 per cent of the total reserves of the United States.

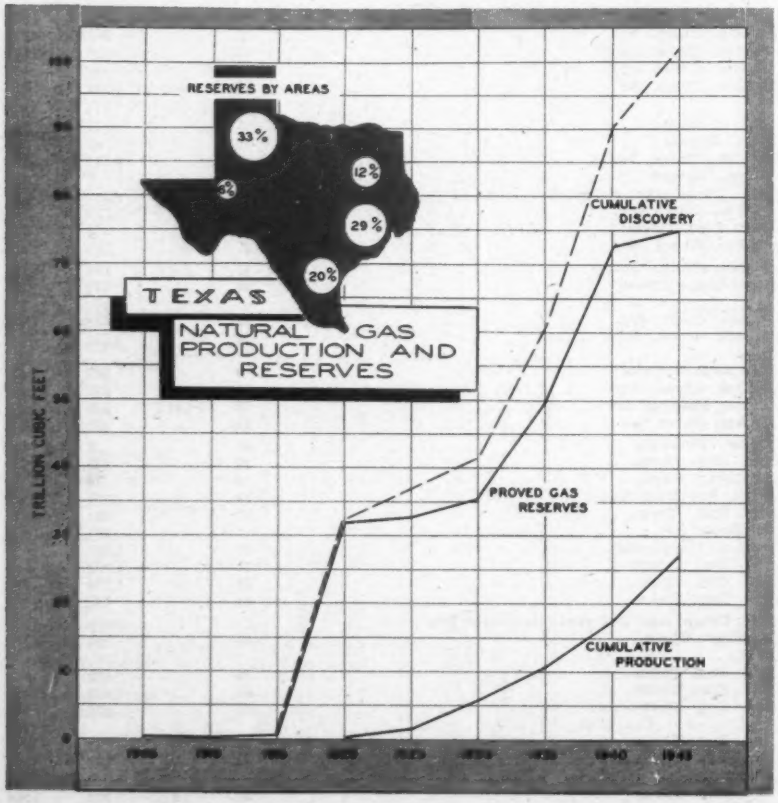
Within the past 15 years, most of the known gas reserves in the Gulf Coast and South Texas areas have been discovered. The depth of drilling has increased steadily, and the gas reserves encountered have been proportionate to the increased depths. It is probable that the improved equipment and technique that has made it possible for the industry to drill deeper in recent years will result in additional discoveries of gas. A much more favorable ratio of natural-gas production to gas reserves is noted than in the case of oil. The present trend shows sufficient supply for a period in excess of 35 years, and with the potential supply increasing annually, it is very probable that gas will continue to maintain a reserve ratio substantially in excess of production.

*Vice president, The Chicago Corp., Corpus Christi, Tex. This article is a slightly abridged version of a paper presented at the Joint Meeting, Texas Sections, A.I.M.E., at Austin, December 18-19, 1946.

War-Years Consumption

Gas consumption during the past 4 years of war shows an increase of approximately 1½ trillion cubic feet annually. At the beginning of the war, the annual gas consumption in the United States averaged approximately 2¾ trillion cubic feet and at the close of the war, it had increased to 4½ trillion cubic feet annually, an increase of more than 50 per cent in less than 4 years. This great expansion in the industry was made possible by the large developed reserves that were not being used at the beginning of the war.

There are, at present, several pipeline companies contemplating expansion of gas sales from Texas, and largely from the South Texas area. One line is now attempting to expand its facilities for transportation and sale of gas into Mexico. Another company is proposing a 30-in. gas line to the West Coast for the transportation of approximately 600 million cubic feet daily, and one of the present pipe-line companies is now expanding its facilities for the transportation of gas into the eastern industrial area from approximately 260 million to 600 million cubic feet daily. Many bidders are trying to obtain the big-inch and little-inch oil lines for the transportation of gas to the New York area in amounts ranging from 300 to 600 million cubic feet daily.



Gas in the eastern industrial area is now worth approximately 25 cents per thousand cubic feet, when compared with coal, on the basis of its heating value. When transportation costs of gas are considered, however, it is not likely that the value of gas will be in excess of 8 cents per thousand cubic feet in the fields of South Texas, unless economic factors not now apparent develop to influence the fuel market.

Technical developments through research before the war and expanded as a war measure, both in this country and abroad, will have a marked bearing on the future value and use of natural gas. The Fischer-Tropsch process, while discovered some 25 years ago, is now developed to the point that one commercial operation is being installed near Brownsville, Tex., at a cost of approximately $20,000,000. The economics of this installation indicate that natural gas may be worth from 8 to 12 cents for the manufacture of such liquid fuels as motor and aviation gasoline. The ultimate realization of such price will require accessibility to adequate gas reserves to afford a long-time operation and will depend largely on the duplication of small-scale results in larger commercial plants.

Another factor influencing the

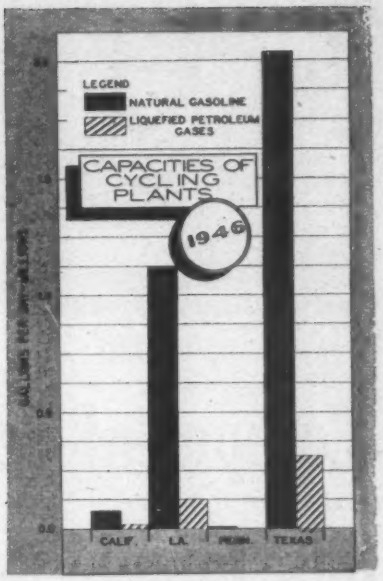
value of natural gas is the conversion of coal to methane and ethane. This process was improvised, using the Fischer-Tropsch synthesis, for the manufacture of gas in Germany during the war. Recent American developments and application of known technique indicates that synthetic natural gas, having a heat content of approximately 1,000 B.t.u. per cu. ft., may be expected in the near future by using the developments of Germany in the Fischer-Tropsch process in connection with American practices in oil-refining technology. Such gas, it is estimated, can be produced at a relatively high pressure from coal at a cost of from 16 to 20 cents per 1,000 cu. ft. Since the coal mines are available near the eastern industrial installations, it can readily be seen that when such developments are completed, the transportation of gas from the Texas area will not justify a very high price at the wells. Consequently, it would appear that the ultimate future price of gas will be influenced largely by the successful development and operation of the Fischer-Tropsch synthesis in converting natural gas to gasoline and liquid fuel rather than its export for industrial fuel to the eastern manufacturers.

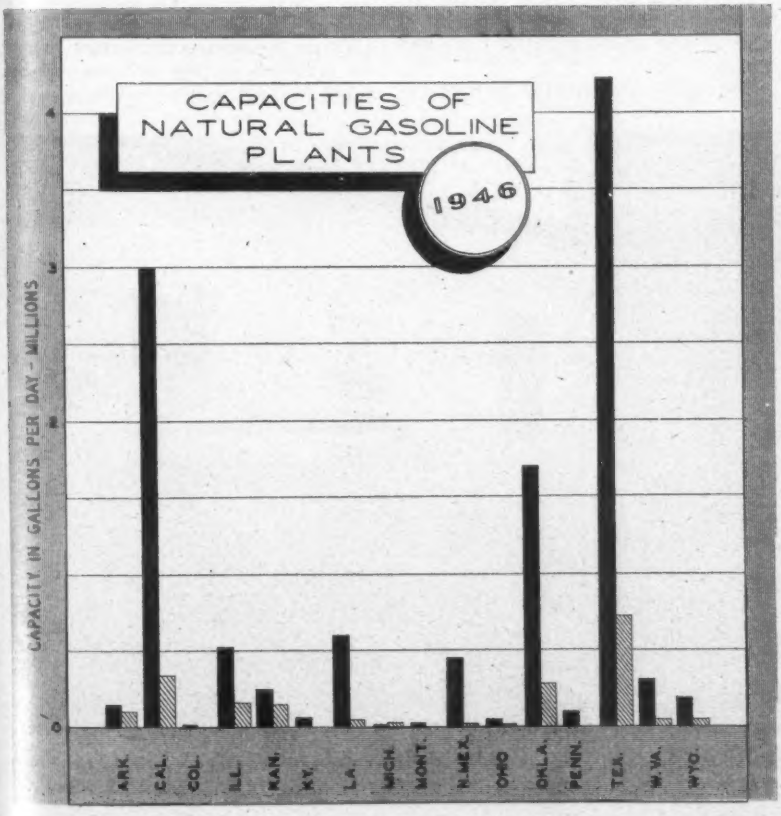
The conservation of gas as a natural resource is largely dependent and contingent upon the value that can be placed on natural gas. One of the most significant gas-conservation developments was started in 1936 in the nature of a pressure-maintenance plant for the return of casinghead gas produced with the crude oil in a field in Louisiana. The casinghead gas was first returned to increase the production of crude oil by maintaining the reservoir energy for lifting the oil. Since then, many operations have been started and in many fields, the ultimate production of crude oil has been doubled because of the return of this gas, and the gas has been conserved for sale or use at some future date when the oil production has been depleted.

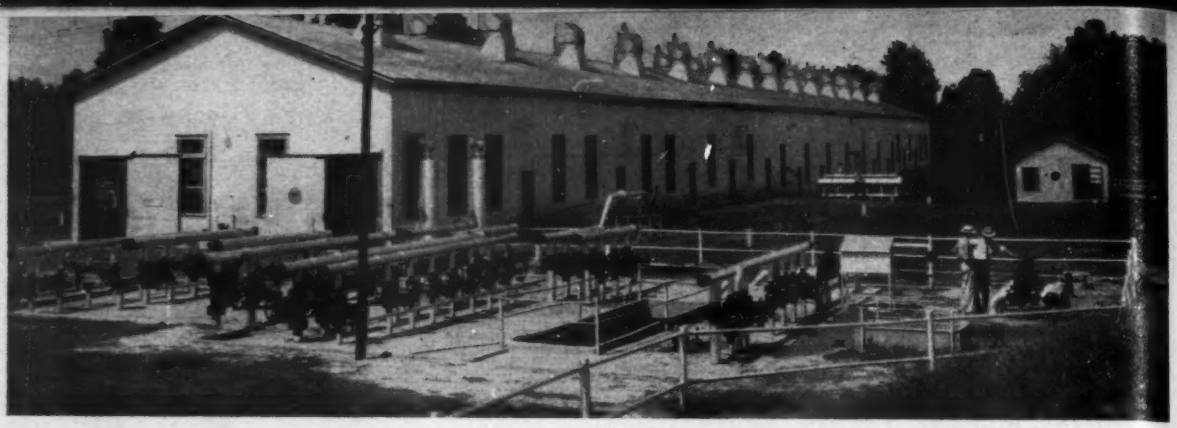
Another significant gas-conservation measure has been the development of the cycling plants, the first of which was started in South Texas in 1936. In the past 8 years, the cycling industry has grown to a total of 27 plants, handling approximately 2,000,000,000 cu. ft. of gas daily, and producing approximately 60,000 bbl. of liquid hydrocarbons in the process. The cycling operation was conceived to convert the then practically worthless gas reservoirs to present values, and to hold the leases until such time as markets could be developed for natural gas. The cycling plant also solved the problem of preparing the gas for market as natural gas produced from a reservoir cannot be normally delivered to pipe lines because of the retrograde condensation that might take place and cause difficulty both in transportation and use.

Conservation has, however, received its greatest boost from increased well-head gas prices, making it practical to conserve this vital raw material. This has been accomplished to date through the long-distance transmission lines that are now operating and from those projected in the near future. They either offer a market or promise one in the near future at a relatively fair price, permitting the gas-well operators as well as the producers of casinghead gas from crude oil to obtain a market affording a return commensurate with their investments. From the operation of interstate pipe lines, both producer and consumer will gain. Those who consume gas will experience a more desirable result because of its convenience and cleanliness, and the producer will receive a fair return.

There is one cloud on free play of competitive enterprise. This exists as a result of the Natural Gas Act. When this act was originally enacted, producers believed that the jurisdiction of federal agencies was clearly limited to (1) transportation of natural gas in interstate commerce, (2) sale of gas in interstate commerce for resale to the consuming public, and (3) natural-gas companies engaged in such interstate transportation or sale. In this belief, the producers of gas were content and continued their normal business of discovery and production, little realizing that this Natural Gas Act would rise to interfere with their operations. The erroneous interpretation of the Natural Gas Act has recently been brought home with its far-reaching effects on the producer. The Federal Power Commission would reduce the well-head price of gas moving in interstate commerce by limiting the return to about 6½ per cent of the total investment of the producer, without regard for risk taken or other factors influencing cause for exploration and development.







Chester station and manifold

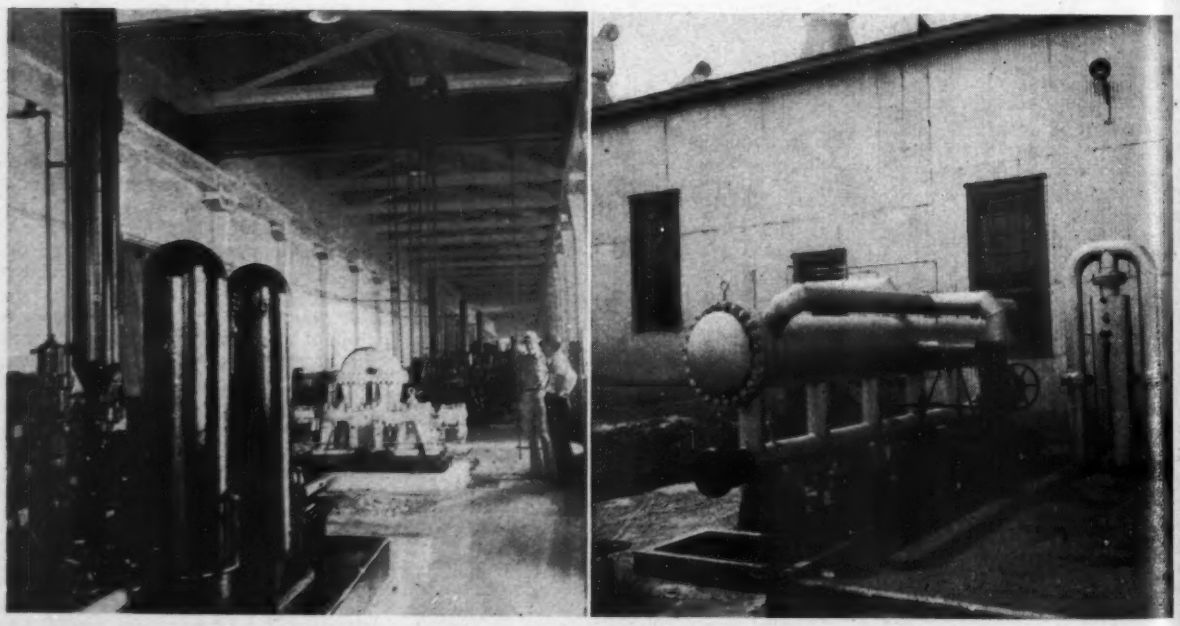
Equipment Features of Two Gulf Pipe-Line Pump Stations

by Paul Reed

SOME of the equipment features at the Sour Lake and Chester pump stations on the southern section of Gulf Refining Co.'s main Texas trunk line are discussed in this article because of their significance for present and future operations. Stations in this section pump south movements of crude oil converging from West Texas, Central Texas, East Texas, Louisiana, and Arkansas, while they also pump north refined products to feed the Project Five system. Furthermore, these stations include steam pumps in service for more than 35 years at South Lake as well as several types of diesel engines driving reciprocating pumps. With the program now being carried out for increasing deliveries from West Texas, installation of one additional diesel centrifugal unit is to be added at South Lake and Chester.

The entire undertaking for increasing capacity of Gulf's West Texas outlet entails installing at each of 12 stations from Midland to Sour Lake a unit consisting of a 860-hp., 360-r.p.m. vertical diesel driving through a step-up gear a six-stage centrifugal pump. Installation work on the units from Midland to Ranger will soon be completed. At stations to the east and south units are to be finished within a few months.

Existing pumping equipment at the two stations is as follows: (1) Sour Lake, six crosscompound corliss steam pumping engines; three vertical diesels (two 400-hp. and one 500-hp.) driving triplex double-acting plunger pumps. (2) Chester, nine diesels (one 400-hp. vertical, one 500-hp. vertical, three 200-hp. horizontal standard twins, four 170-hp. horizontal twins), three 150-hp. horizontal single-cylinder diesels; the pumps are duplex and triplex double-acting plunger type. (Within a year superchargers are to be installed on the 400 and 500-hp. units at Sour Lake station.)



Left: Pump room, Chester station, with new diesel-driven centrifugal pump in middle foreground. Right: Water and scale trap on main pump suction line and surge chamber, Chester station

Special attention has been given to removing material of various kinds which causes trouble. Measures for this purpose include the following: (1) Scale traps of types similar in principle to those now serving reciprocating pumps on the products system, will be installed at stations at the western end of the West Texas crude-oil system and as far eastward as conditions warrant. Scale traps on the products line have been useful in removing free water and scale. Consequently, plunger scoring and packing trouble has been much reduced. (2) All 12 stations of the West Texas line will be equipped with fuel-oil centrifuges. (3) Lubricating oil for the new West Texas line units will pass through bauxite filters.

With the present system at Sour Lake the lubricating oil for three vertical engines is cleaned in rotation in the following sequence: (1) Duplex strainer; (2) centrifuge; (3) filter.

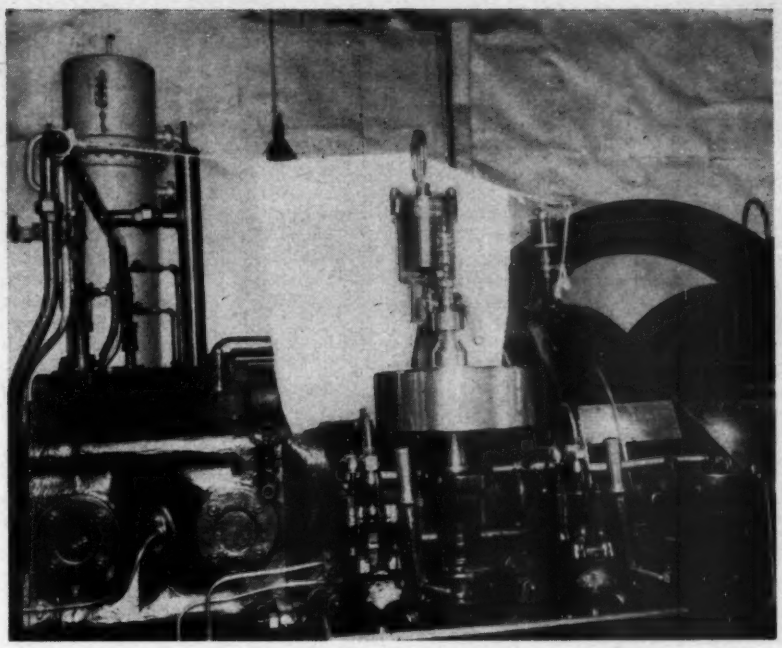
Unusual Protective Device

A unique device is used to protect engines against possible danger while oil is centrifuged. This consists of two four-way plug valves connected together with gears which may be locked in position so that proper pipe connections are in service for handling the oil to the particular engine having its oil cleaned. Consequently, the opening and closing of individual valves and the possibility of errors are eliminated.

Lubricating oil for horizontal engines is batched for treating through reclaimers. On both the suction and discharge lines at the Chester station, surge chambers are installed.

For pumping products north to feed the Project Five system which continues to deliver at Helena, Ark., (for transshipment to Mississippi River barges), several units previously pumping crude oil south were converted during the war to pumping gasoline north. Units converted to products service at the various stations differ both in number and horsepower.

In order to operate the products line as a closed system it was necessary to synchronize the operation of the reciprocating pumps. This was accomplished by the installation of sylphon bellows controls for regulating engine speed through connection with the governor. Sylphon bellows controls were installed at Sour Lake, Lufkin, Timpson (all in Texas); Mansfield and Dubberley (both in Louisiana). Speed of the engine is regulated by suction pressure acting on the sylphon bellows device. Special equipment for installing these controls on the pumps was fabricated in the company shops.



Sylphon bellows suction-pressure governor control applied to De La Vergne fly-ball governor for closed refined products system at Chester station

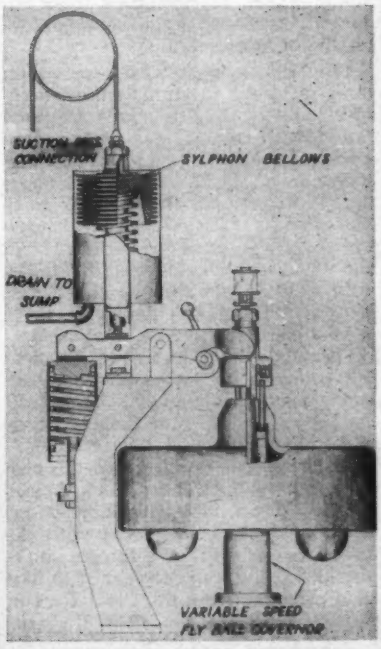


Diagram of sylphon bellows showing equipment fabricated especially for installation to control diesel engine governor

Lubricating oil centrifuge showing plug valve gear for switching oil to various units

GAS CONSERVATION IN WEST TEXAS

by D. V. Carter

GEOGRAPHICALLY, West Texas area is generally considered to approximate the Texas portion of the Permian basin and is included in the Texas Railroad Commission districts 7-C and 8. The remainder of the Permian basin covers the southeastern corner of New Mexico and is being omitted in this paper.

Before going into the discussion of gas-conservation practices in West Texas, it might be well to consider the meaning of the term "conservation." Conservation in relation to natural resources is defined as "the preservation of natural resources for economical use." Natural gas is an irreplaceable naturally occurring resource, migratory in nature, and expensive and difficult of storage except in the natural reservoirs in which it is found. Gas conservation does present some problems. However, these problems are not insurmountable if all concerned work cooperatively toward the common objective of conservation.

The gas of West Texas occurs in three different environments with respect to oil: (1) Gas sands nonassociated with oil; (2) gas caps associated with oil; (3) solution gas dissolved in oil. By far the most important source of gas in West Texas to this date is solution gas, with gas-cap reserves a good second, and free-gas reserves a very poor third. Hence, with solution gas topping the list, it is apparent that the development of gas reserves in the area should closely parallel those of crude oil, and the problem of proper conservation and utilization of natural gas is intimately entwined with that of crude oil production.

The first sustained crude-oil production in West Texas, and, hence, the first appreciable quantity of gas to be produced came about with the discovery of the Westbrook field, Mitchell County, in the year 1920. The field produces from the Clear Fork of Permian age. However, the first big strike of the area that attracted widespread attention was the Big Lake field, Reagan County, discovered in July 1923. Big Lake first obtained its production from the San Andres lime of Permian age. Later in 1928 Big Lake developed the first Ordovician production for West Texas.

Table 1 shows dates and discovery fields with respect to important geological "firsts."

TABLE 1—WEST TEXAS IMPORTANT PRODUCING ZONES WITH DISCOVERY FIELDS*

Zone, field and county—	Date of discovery
Permian:	
Yates-Capitan, Hendrick, Winkler	1926
Grayburg, McElroy, Crane & Upton	1926
San Andres, Big Lake, Reagan	1923
Clear Fork, Westbrook, Mitchell	1920
Pennsylvanian, Todd, Crockett	1940
Devonian, Wheeler, Winkler	1944
Silurian, Shipley, Silurian, Ward	1940
Ordovician, Big Lake, Reagan	1926

*World Petroleum, 15 (3) 44 March 1945, "Permian Basin Pays Are Many—and Deep," Paul F. Osborne.

D. V. Carter is chief petroleum engineer for Magnolia Petroleum Co., Dallas, and is active in several committees of the American Petroleum Institute. This article was presented as a paper before the state-wide meeting of the American Institute of Mining and Metallurgical Engineers in Austin, Tex., December 18-19.

Last Major Frontier

This portion of Texas geographically constitutes one of the last major frontiers for the finding and development of additional oil and gas fields. We must keep in mind that the great bulk of the fields discovered together with cumulative oil production, amounting to 96.3 per cent of all the oil produced to date for this region, has been from rocks of Permian age. The area is even less explored and developed with respect to the pre-Permian rocks. A vast amount of exploration work remains to be done before even a semblance of understanding of the pre-Permian geology becomes an accomplishment. This means that the industry can confidently look forward to additional oil and gas reserve increments from this region. With the uncovering of these new sources of hydrocarbons will come the equally urgent need and demand for gas conservation, if maximum recovery and utilization of these resources is to be realized.

The petroleum industry as well as the nation has arrived at the point where it is no longer debatable or even questioned that the very best talent and technique must be employed if private industry is to continue to enjoy the trust it has earned to date by virtue of having provided for the consuming public all petroleum products needed at a reasonable price.

Without involving ourselves in the matter of how long our present reserve of oil and gas will last, together with a discussion of the amount of reserve yet to come by future discovery, all of us familiar with the matter of reserves are cognizant of the fact that each field found and exploited means one less field, and that the unknown reserve or unproduced reserve is reduced to that extent. If we assume that X represents that quantity of total proved and undiscovered reserve of naturally occurring hydrocarbons, it is obvious that by whatever means we are able to improve the recovery and utilization and thereby accomplish true conservation in the broadest sense, we will have as an industry demonstrated our right of delaying that time when other sources will begin to implement our supply of raw hydrocarbons. Also, we will have proved that private industry conducted along competitive lines is a constant incentive which guarantees constant improvement of technique and thereby provides the background and environment for just and rightful economic reward. This is as it should be.

Two outstanding authorities have aptly expressed the economic environment necessary for the conservation of natural gas with which we are here chiefly concerned.

DeGolyer* has stated: "Until quite recently, the oil industry was little concerned with gas. In the past, many gas shows were plugged and abandoned or neglected because of inaccessibility to market or the prevailing low prices paid for gas. This practice is not likely to continue in the future. If gas is encountered, it will be exploited because additional markets and uses for gas have been and will continue to be developed. If there is a steadily increasing market demand for gas, underground reserves will acquire values which they have not previously had and exploration for gas itself will be carried on in favorable areas instead of in a few localities where additional supplies of gas are required."

Ernest Thompson, of the Texas Railroad Commission, only recently said: "Conservation can go no further than enlightened public opinion will support. When the market for gas gets strong enough, the owners of this flare gas from oil wells will collect it and sell it. Self interest will save

*Natural Gas Reserves of the United States as of January 1, 1946, by DeGolyer & McNaughton, June 1946, prepared for E. Holley Poe & Associates.

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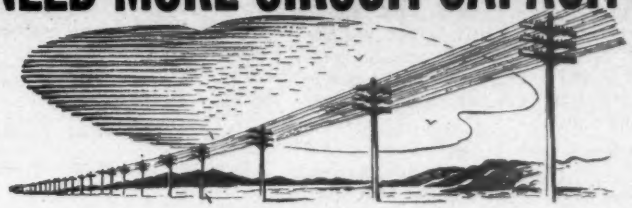

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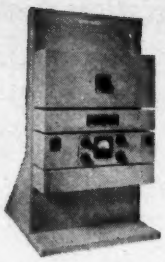

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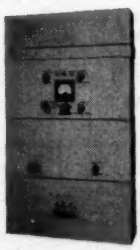

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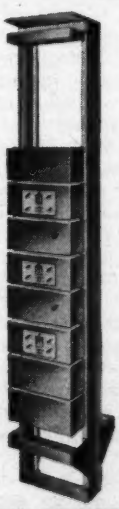

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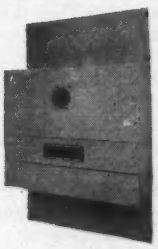

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it when the price justifies collecting it.

"Price is, after all, the greatest conservation agent on earth. You cannot make a man save that which has no value. Neither can you confiscate a man's property in attempting to make him conserve that which is without present value."

I cannot add to or improve the statements of these two authorities. For that matter, price is the best conservator of anything, whether it be a natural resource, product of a natural resource, or a piece of art.

Looking back, only 23 years have elapsed since the Big Lake field was found—the discovery of which sent interest soaring in West Texas. Considering the lack of markets, even though transportation facilities existed and served local markets, several other handicaps and situations were present which prevented conservation and utilization of gas from becoming a reality. In the first place, oil production did not have the benefits of being produced on a basis which involved consideration of reservoir control. Consequently, each new field upon discovery was usually rapidly developed and the gas accompanying such production had a like peak of production followed generally by a precipitous decline. Under such conditions investment of capital for gathering and transporting such a variable supply of gas was considered as too hazardous economically and therefore not a good risk.

Other Supplies More Available

Then too, other gas supplies were more readily available which were more attractive from a profit standpoint—such as the great Panhandle gas field to the north. Another limitation was the fact that most of the gas contained appreciable quantities of H_2S (hydrogen sulfide), to the extent that treatment was required before the gas was marketable. Then too, treatment technique had not been developed to the point where it is now as regards costs. With these problems confronting the industry it is small wonder that markets for West Texas gas have been slow in developing. West Texas, or that part of the Permian basin which is located in West Texas, is estimated to have produced up to approximately a year ago —January 1, 1946—1,710 million barrels of crude oil which I estimate to be subdivided as follows: 1,645 million barrels of crude oil from Permian and higher formations, and 65 million barrels of crude oil from pre-Permian rocks. Cumulative gas production for the area is: 6,945,627 millions of cubic feet at 14.65 lb. pressure base.

Table 2 shows the production and principal disposition of reported gas for 1944 and 1945 in West Texas.

It is interesting to note that from a modest beginning in West Texas during the mid-1920's gas processing has grown to the extent where 85 per cent of the gas reported produced in 1945 was plant processed for liquid extraction.

Table 3 shows the active liquid extraction plants of West Texas.

It should be pointed out that three carbon-black plants (Cabot) of the West Texas area appear in the table of liquid-extraction plants. They, of course, strip the incoming gas of liquids, and use the dry residue gas to manufacture carbon black.

Until just recently West Texas had remained more or less the orphan region of the state with respect to pipeline outlets for gas. Last year a gathering line was extended into the Keystone field from a distributing system that sells gas in New Mexico and Arizona, marking the first interstate movement of gas from West Texas.

All of the above gives an idea of what part transportation of gas to markets, gasoline, and carbon black plants, as well as field development, plays with respect to the utilization of natural gas from this area.

Let us now consider to what extent secondary recovery by gas injection and pressure maintenance of oil reservoirs has contributed to gas conservation while making possible the realization of greater oil recovery.

Over the last 19 years starting with the Cook Ranch field, Shackleford County, numerous projects have been started individually by operators owning either a small or major portion of a field. As in the case of the McElroy field, Crane County, these projects are in tune with the advance in petroleum production technology. They have not achieved, individually, uniform success. This is partly due to lack of unitization, and meager knowledge of reservoir conditions and important data of a geologic nature.

I personally know of one repressuring project in the Yates sand with which only mediocre success was obtained because of a lack of fundamental reservoir conditions which involved both geological and engineering data. Years after the start of this project a well was drilled for the express purpose of obtaining data relating to gross thickness of pay, net thickness of productive pay, core analysis, and other related data. The information revealed by the drilling and testing of this well was so much different from the original conception and estimate of prevailing reservoir conditions that it resulted in a vastly different concept of what the problem was originally. As a result, a delayed and new approach was necessary which, in itself, cannot be as effective, because in the meantime the reservoir is largely depleted of its oil and gas content. Actually the reservoir was much smaller than originally believed.

Table 4 is a list of secondary and

TABLE 2—PRODUCTION AND PRINCIPAL DISPOSITIONS OF GAS IN WEST TEXAS 1944-1945

M.m.c.f.*

	Production			Disposition			
	Gas well	Casing-head	Total gas	To gasoline plants	To carbon black plants	Repressuring	Vented and line loss
1944:							
District 7-C	1,269	2,508	3,777	2,508	0	0	408
District 8	14,404	93,511	107,915	89,508	18,660	1,930	43,818
Total W. Texas	15,673	96,019	111,692	92,016	18,660	1,930	44,224
1945:							
District 7-C	1,177	1,831	3,008	1,876	0	0	31
District 8	12,851	126,521	139,372	119,674	34,886	3,269	54,097
Total W. Texas	14,028	128,352	142,380	121,550	34,886	3,269	54,088

*All figures are totals for the respective years at pressure base of 14.65 psi.—from Railroad Commission of Texas.

TABLE 3—GASOLINE PLANTS, WEST TEXAS*

Operator; field; county—	Capacity M.c.f.
Odessa Gasoline Co.; Foster; Ector	14,000
Texon Oil & Land Co.; Big Lake; Reagan	50,000
Cabot Carbon Co.; North Ward; Ward	30,000
Cabot Carbon Co.; Keystone; Winkler	30,000
Cabot Carbon Co.; Kermit; Winkler	38,000
Cities Service Oil Co.; North Cowden; Ector	60,000
Gulf Oil Corp.; North Ward; Ward	25,000
Magnolia Petroleum Co.; Kermit; Winkler	30,000
Phillips Petroleum Co.; McElroy; Crane	22,000
Phillips Petroleum Co.; Goldsmith; Ector	50,000
Phillips Petroleum Co.; Penwell; Ector	22,000
Phillips Petroleum Co.; Seminole; Gaines	28,000
Phillips Petroleum Co.; Fullerton; Andrews	45,000
Shell Oil Co., Inc.-Coltexo Corp. Nos. 1 and 2; Wasson; Yoakum	60,000
Standard Oil Co. of Texas; South Ward; Ward	18,000
Luse & Ice; Payton; Ward	(†)
C. V. Lyman; Emperor (Deep); Winkler	6,000
Total	528,000

*V. E. Cottingham, North Basin Pools Engineering Committee. †Repressuring.

TABLE 4—WEST TEXAS PRESSURE-MAINTENANCE PLANTS, DISTRICT NO. 8*

Field and operator—	County	Date commenced operations	Gas intake D/A M.c.f.	Gas injected D/A M.c.f.
Cedar Lake—Stanolind Oil & Gas Co.	Gaines	April 1946	384	228
Hendrick—Stanolind	Winkler	June 1946	319	319
Kermit—Gulf Oil Corp.	Winkler	Jan. 1945	537	511
Kermit—Magnolia Petroleum Co.	Winkler	1939	5,445	5,009
Kermit—Monday Oil Co.	Winkler	1941	442	227
Kermit—Sun Oil Co.	Winkler	Jan. 1942	390	225
Payton—Luce & Ice	Pecos & Ward	Sept. 1941	1,200	975
Ward, North—Gulf	Ward	Dec. 1944	19,961	2,259
Total			28,678	9,753

*None in 7-C. Source: Perry Alcott, Humble Oil & Refining Co., Houston.

TABLE 5

Name of committee—field, county—	Date organized
Yates Pool Engineering Committee—Yates, Pecos and Crockett	1928
Judkins Pool Engineering Committee—Judkins, Ector	1934
Goldsmith Pool Engineering Committee—Goldsmith, Ector	1937
North Basin Pools Engineering Committee—Seminole, Gaines; Russell, Gaines; Wasson, Gaines & Yoakum; Wasson "66," Gaines; Wasson "72," Gaines; Waples-Platter, Yoakum; Owenby, Yoakum; Dean, Cochran; Slaughter, Cochran, Hockley, & Terry; Levelland, Hockley	1939
Fullerton Engineering Committee—Fullerton, Andrews	1944

pressure-maintenance projects together with year of origin, and it shows the importance of applied petroleum engineering technology to such projects.

In addition, the cooperative type of fact-finding petroleum engineering committee should be mentioned for the very important part it is playing in the constant collection of factual data of an engineering and geological nature. A list of these committees is given in Table 5. Additional committees for the Dollar Hide and TXL fields are in the formative stage.

Let us now take a look at what is being planned for the future utilization of West Texas gas. It is difficult to obtain even a reasonably accurate check of the amount of flare gas being wasted. All of it is not reported to the Railroad Commission and many reported tests are hardly more than spot checks. However, estimates run from 150 to 225 million cubic feet per day of flare gas for West Texas.

Perhaps the largest single project for utilizing wasted gas is the forthcoming Texas-California 26-in. transmission line of El Paso Natural Gas Co. The line will provide gas-starved California with a source of natural gas for some years to come and will also provide Texas with an income for a hitherto wasted natural resource. The ultimate capacity of the line of 305 million cubic feet per day will be reached by September 1, 1949. It is estimated that 75 per cent of this figure will be supplied by residue gas now being vented to the air.

New Plants and Injection Projects

Many new plants and injection projects are being planned for West Texas fields. It is estimated that more than $50,000,000 is to be spent for gas utilization projects. Table 6, compiled from Texas Railroad Commission statistics, lists proposed gas processing plants for which some concrete planning has been done.

Virtually every hydrocarbon reservoir of any size in the West Texas area is currently undergoing a close scrutiny, and engineering studies are either under way or being discussed for future action for most of them. Such technical studies have just been completed for the Slaughter and Goldsmith fields. In the Slaughter field it was deemed advisable to sell most of the gas, although a small amount is to be injected. Press notices say that a combined gasoline and injection plant is to be built at the Slaughter field. The entire project is to cost about $20,000,000. The study of the problem of a large gas cap in the Goldsmith field resulted in plans to repressure the reservoir. Stanolind Oil & Gas Co. is to spend about $7,000,000 on the project.

Injection is being encouraged by the Railroad Commission. Credit is allowed to wells producing in excess of the gas-oil ratio allowed by the commission by the amount of gas injected into the producing formation.

Another feature of utilization which is looming brightly on the horizon of improved gas technology is the advent of mass-produced oxygen. Experts say that by large-scale production the price of oxygen may be reduced from the present cost of about $70 per ton down to about $3 per ton. When this cheap oxygen is combined with such processes as the Hydrocol and the Fischer-Tropsch to manufacture gasoline from natural gas, wonders are expected. Current estimates are that gasoline can be produced from natural gas for as low as 5 cents per gallon—compared to the present cost in the Texas Gulf Coast of 7¼ cents per gallon. Greatly improved yields from these processes, it is estimated, could extract 17 billion barrels of gasoline from the 175 trillion cubic feet of present gas reserve in

(Continued on page 86)

TABLE 6—PROPOSED GAS PROCESSING PLANTS FOR WEST TEXAS

Field and county—	Description of Project	Operator	Approx. Daily Gas Volume	Disposition of Residue	Status, Sept. 1946
McElroy—Crane and Upton	Experimental injection plant	Gulf	1 to 2 M.M.c.f.	Injection	Planning
Keystone—Winkler	Gasoline and compressor plant	Joint operation	50 M.M.c.f.	Sales	Planning
Kermit—Winkler	Compressor plant	Magnolia	10 M.M.c.f. residue gas	Sales and injection	Plans nearly complete
TXL—Ector	Gasoline plant	Shell	30 M.M.c.f.	Possible sales	Planning
Block 31—Crane	Gasoline and compressor plant	Atlantic		Indefinite	Planning
Slaughter—Cochran, Hockley, Terry	Gasoline and compressor plant	Joint operation	43 M.M.c.f. now flared	Sales and injection	Plans nearly complete
Goldsmith—Ector	Gasoline and compressor plant	Joint operation	7.3 M.M.c.f.; ultimate capacity, 20 M.M.c.f.	Sales and injection	Planning unitization
Cedar Lake—Gaines	Experimental compressor plant	Stanolind	3 M.M.c.f. flare gas	Injection	Contract has been let
N. and S. Cowder—Crane and Upton	Compressor plant	Stanolind	35 M.M.c.f.	Injection	Planning
Foster—Ector	Compressor plant	Stanolind	15 M.M.c.f.	Injection	Planning
Harper—Ector	Compressor plant	Stanolind	1.2 M.M.c.f.	Injection	Planning
Hendricks—Winkler	Compressor plant	Stanolind	0.15 M.M.c.f. gas lift gas	Injection	Planning
Fullerton—Andrews	Compressor plant	Joint operation	40 M.M.c.f. flare gas	Injection	Planning unitization
Seminole—Gaines	Compressor plant	Joint operation		Injection or sale	Possibilities being studied
N. Ward-Estes—Ward	Addition to present gasoline and compressor plant	Gulf	2.5 M.M.c.f. residue	Injection	Planning

Injection Well and Water Requirements

*by Park J. Jones**

PART 10 OF A SERIES

OIL PRODUCTION by water

WHEN a reservoir is saturated with producing wells produced at capacity, a decline in reservoir pressure is accompanied by a decline in producing rate. So the burden of maintaining producing rates is placed on injection wells. However, differences between producing and injection wells as to interference factors, permeability, completion in pay, and fluid viscosities usually favor a higher operating reservoir pressure, more injection wells, and fewer producing wells. As a rule, the optimum reservoir pressure is the pressure which requires the least total number of wells. Differences in operating expenses as between pumping and injection wells may also favor a greater number of injection wells. The total volume of water handled depends primarily on how much oil is produced before water appears in production. The dry oil reserve is a measure of water injection requirement. The greater the distance between injection and producing wells, the higher the oil recovery before water appears in production.

The Required Injection Wells

LET Q_o be the rate of oil production from a pay interval or from a portion of a given pay interval. Denote the corresponding volumetric rate of production by JQ_o where J is the volume factor for the produced fluids which may include oil, free gas, and water. On the assumption that the volume factor for water is equal to unity, the water requirements are JQ_o barrels per day if there be no change in reservoir pressure. Suppose a fraction (1 — A) of the total water requirements is available by encroachment. Then the required rate of water injection is AJQ_o barrels per day. The number of required injection wells is defined approximately by:

$$N_w = \frac{AJQ_o \mu_w \log 2d/r}{3.07\,(IhK\Delta P)_w} \qquad (1)$$

where

d = average distance from injection to producing wells, ft.
h = average pay thickness for N injection wells, ft.
I = interference factor for N injection wells
K = average effective permeability to water for reservoir-well system, darcys
$\Delta P = P_w - P_r$ = average buildup for N injection wells, psi.
P_r = reservoir pressure, psia.
P_w = operating bottom-hole injection pressure, psia.
μ_w = viscosity of water, cp.
r = radius of well bore, ft.
$(IhK\Delta P)_w = I_w h_w K_w \Delta P_w$
log is to base ten.

Example 1.—Estimate the number of injection wells required for the following conditions:

JQ_o = 20,000 bbl. per day
A = 0.8
d = 2,000 ft.
h = 30 ft.
I = 0.64
K = 400 md.
ΔP = 200 psi.
μ_w = 0.8 cp.
r = 4.0 in.

In this example:

$$\log \frac{2d}{r} = \log \frac{4{,}000\ (12)}{4.0} = 4.08$$

so

$$N_w = \frac{0.8\ (20{,}000)\ (0.8)\ (4.08)}{3.07\ (0.64)\ (30)\ (0.4)\ (200)} = 12 \text{ wells}$$

The per-well rate of water injection averages 0.8 (20,000)/12 (200) (30) or 0.22 bbl. per day per foot of completion per pound buildup.

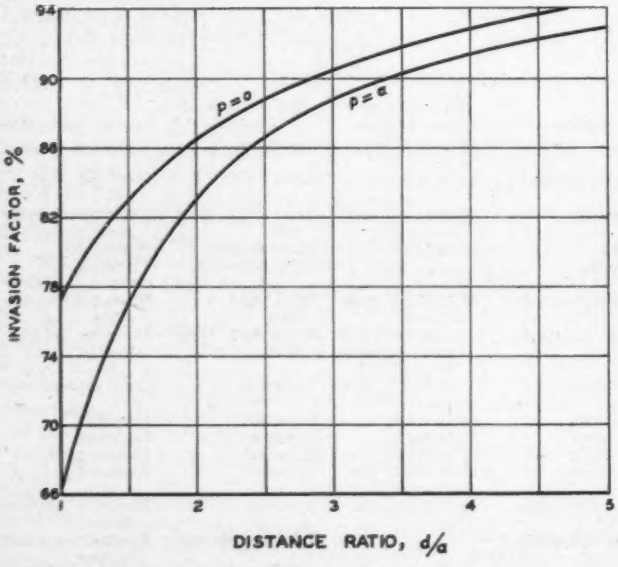

Fig. 10-1—Invasion factor for the B contour vs. distance ratio d/a; d is distance between producing and injection rows; (a) is distance between injection wells on a row; p is distance between producing wells on a row

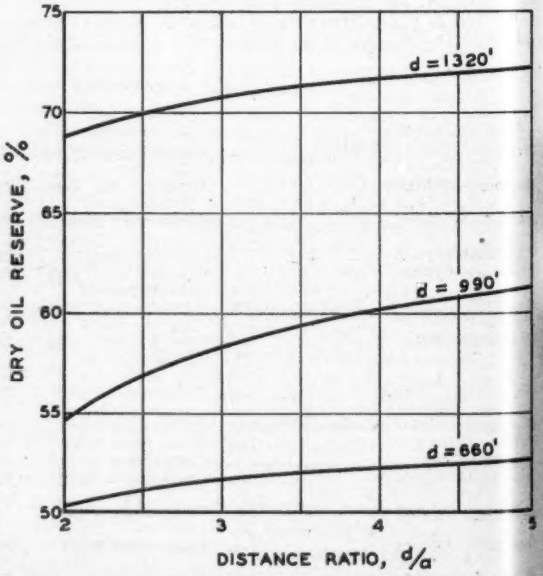

Fig. 10-2—Approximate dry oil reserve in per cent of recoverable oil vs. distance ratio d/a; fluid factor equals four; convergence is unity

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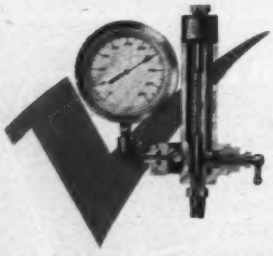

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Control of Injection Rates

Let N_i be the number of injection wells required in the ith pay interval or sector. Then:

$$N_i = N \frac{\left(\frac{AJQ}{IhK\Delta P}\right)_i}{\Sigma \left(\frac{AJQ}{IhK\Delta P}\right)_i} \qquad (2)$$

where

N = total number of injection wells or completions
$(AJQ)_i$ = rate of water injection into the ith interval or sector
$(IhK\Delta P)_i$ = product of the average feet of completion, permeability, buildup and interference factor for the ith interval

The viscosity of water is assumed to be uniform. The influence of differences in distances between producing and injection wells is usually nominal. However, distances may be incorporated by including the factor log 2d/r in Equation 2 when necessary.

Example 2.—Distribute 50 injection wells to the best advantage among three sectors of a pay when the conditions are as follows:

Sector	1	2	3	
AJQ, bbl. per day	2,000	3,000	5,000	
h, ft.	10	15	25	
K, md.	100	200	400	
Solution aside from I_i				
$(hK)_i$	1,000	3,000	10,000	Σ
$(AJQ/hK)_i$	2	1	0.5	3.5
N_i	29	14	7	50

In this example, each sector has more than five injection wells. No correction for interference is required. The buildup is about the same for all wells.

Example 3.—Estimate the buildup required under the conditions of Example 2 if the viscosity of water is 0.8 and the factor log 2d/r is equal to 4.08 for all sectors.

By Equation 1:

$$\Delta P_i = \frac{0.8\ (4.08)\ (AJQ)_i}{3.07\ (0.64)\ (NhK)_i} = 1.66 \left(\frac{AJQ}{NhK}\right)_i$$

Sector	1	2	3
AJQ	2,000	3,000	5,000
N	29	14	7
h	10	15	25
K	0.1	0.2	0.4
$(NhK)_i$	29	42	70
ΔP_i, psi.	114	119	119

Suppose the desired rate of oil production from a pay interval or a sector in a given pay interval is Q. The required number of producing wells N_o relative to a reservoir pressure P_o is given approximately by:

$$N_o = \frac{Q\ (b\mu)_o \log 2d/r}{3.07\ (IhK)_o\ (P_o - p_o)} \qquad (3)$$

The required number of producing wells N_r for the producing rate Q and relative to a reservoir pressure P_r and a bottom-hole operating pressure P_b is defined approximately by:

$$N_r = \frac{Q\,(b\mu)_r \log 2d/r}{3.07\,(IhK)_r\,(P_r - P_b)} \quad (4)$$

As a rule, the influence of the variation in the distance d for a reasonable number of wells is nominal. Similarly, the variation in the average completion, h, with a reasonable number of wells is also nominal. On the assumption that the influence of the number of wells on the average value of d and h is negligible, we have:

$$N_r = N_o \frac{(b\mu)_r\,(IK)_o\,(P_o - p_o)}{(b\mu)_o\,(IK)_r\,(P_r - P_b)} \quad (5)$$

According to Equation 5, a decline in reservoir pressure for which:

$$\frac{(b\mu)_r}{(b\mu)_o} \times \frac{(IK)_o}{(IK)_r} > 1 \quad (6)$$

increases the number of required producing wells when the decline in reservoir pressure is not offset by an increase in the drawdown $(P_r - P_b)$. If the bottom-hole pressure p_o is a minimum flowing or pumping pressure, the operating pressure P_b is equal to p_o. In this case, a decline in reservoir pressure causes the pressure ratio to take on values greater than unity, thus:

$$\frac{P_o - p_o}{P_r - P_b} > 1 \quad (7)$$

The increase in the number of wells required to produce oil at a given rate is now proportional to the product of Equations 6 and 7. But if the N_o wells constitute a three-row system, the drilling of the additional wells $(N_r - N_o)$ will not increase producing-well capacity. A reduction in reservoir pressure would be accompanied by a decline in oil-producing rate even if the additional wells are drilled. So the burden is placed on injection wells.

The required number of injection wells N_w relative to a reservoir pressure P_o is given approximately by:

$$N_w = \frac{AJ_o\,Q\mu_w \log 2d/r}{3.07\,(IhK)_w\,(P_w - P_o)} \quad (8)$$

The required number of injection wells N_{wr} relative to a lower reservoir pressure P_r is defined approximately by:

$$N_{rw} = A\left(\frac{P_i - P_o}{P_i - P_r}\right)\left[\frac{J_r Q\mu_w \log 2d/r}{3.07(IhK)_w(P_w - P_r)}\right] \quad (9)$$

where P_i is the initial reservoir pressure. The rate of water encroachment at a given time is proportional to the drawdown on encroaching water. Accordingly, the comparable burden on injection wells is in the pressure ratio $(P_i - P_o)/(P_i - P_r)$.

Upon combining Equations 8 and 9, we have:

$$N_{rw} = N_w \left(\frac{J_r}{J_o}\right)\left[\frac{(P_i - P_o)(P_w - P_o)}{(P_i - P_r)(P_w - P_r)}\right] \quad (10)$$

According to Equation 10, a decline in reservoir pressure increases the number of required injection wells in the ratio J_r/J_o of volumetric withdrawals per barrel of produced oil. But at the same time, the required number of injection wells is reduced in the ratio given by the pressure factors within the brackets of Equation 10.

Let N equal the total number of wells. Relative to the pressure P_o:

$$(N)_{P_o} = N_o + N_w \quad (11)$$

But relative to the reservoir pressure P_r:

$$(N)_{P_r} = N_r + N_{wr} \quad (12)$$

Summing up, the number of injection wells required by a reservoir depends on the number of producing wells. The number of producing and injection wells combined varies primarily with operating reservoir pressures. The optimum reservoir pressure usually is the pressure for which the total well requirements are least. However, differences between producing and injection wells as to interference, permeability, well-feet of completion, and reservoir liquid to water viscosity ratio should be applied advantageously. Similarly, the cost of injecting water as compared to the cost of pumping or flowing oil may also be used in minimizing the total well requirements for a reservoir. Applications of these rules will be illustrated in later articles.

Invasion Factor for Rows

The invasion factor for a B contour relative to injection wells uniformly spaced on a circle was given in Part 9 and is reproduced here as the p = 0 curve in Fig. 10-1. The data are plotted against the distance ratio d/a where d is the distance between a row of injection wells and a row of producing wells and "a" is the distance between injection wells. The p = a curve is for distances p between producing wells equal to distances "a" between injection wells.

The invasion factor is in per cent of the area between producing and injection wells for the interval in which water breaks through into producing wells. If water advances at unequal rates as between pay intervals, the invasion factor for all other intervals is less than that for the breakthrough interval. The derivation of

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the invasion factor for rectangular shapes is not included here because of space limitations.

Dry-Oil Reserve

For distances less than 1,000C ft., a dry-oil reserve is defined approximately by:

$$m = 28 + \frac{Id}{1{,}000}(17.3 + 8.7C) - F \quad (13)$$

where

m = per cent of in-place oil
C = convergence of reserve
F = fluid factor
d = distance between injection and producing rows
I = fraction of distance d invaded at breakthrough

For Id = 1,000 ft., the displacement factor is given by:

$$m = 45.3 + 8.7C - F \quad (14)$$

For Id > 1,000 ft., the composite displacement factor m_o is defined by:

$$m_o = (80 - F)\left(1 - \frac{1{,}000}{Id}\right) + \left(\frac{1{,}000}{Id}\right)m \quad (15)$$

where m is defined by Equation 14.

The curves in Fig. 10-2 illustrate solutions of the foregoing equations for C = 1, F = 4 and p = a. Values of I corresponding to a given d/a were obtained from Fig. 10-1. The slope on a curve shows the influence of the displacement factor on dry oil reserves. The data are for the breakthrough interval. The oil produced from other intervals at the time of breakthrough is less than that for the said interval.

Produced and Injected Water

Dry-oil reserve is a measure of water requirements. If 100 per cent of a reserve could be produced dry, there would be no water in production and the injection requirements would be only b times a reserve where b is the volume factor for oil. But the invasion factor is not 100 per cent and the displacement factor can be considerably less than 100 per cent at breakthrough. Consequently, a significant fraction of recoverable oil may have to be produced as wet oil. The difference between recoverable oil and dry-oil recovery is wet-oil reserve and marginal-oil reserve. A small dry-oil recovery means that more oil has to be produced wet or else the ultimate recovery is smaller and the marginal reserve is higher at abandonment.

Consider a rectangle 330 by 2,640 ft. produced either as four 330 by 660-ft. units or two 330 by 1,320-ft. units. Let the recoverable oil be 200,000 bbl. per 330 by 660-ft. unit. In Table 10-1, the estimated wet and marginal reserve is 228,000 bbl. for the two 1,320-ft. units and 400,000 bbl. for the four 660-ft. units. If this oil could be recovered with 5 bbl. of water per barrel of wet oil, there would be a difference of 1.72 million barrels in the total volume of water handled in favor of operating two units rather than four units.

The foregoing data are relative to producing recoverable oil. But when the per cent cut reaches an economic limit operations are abandoned. Therefore, unnecessary splitting of reservoirs makes for bigger marginal reserves and smaller ultimate recoveries. Split reservoirs have a faster producing rate. But the operating expenses may be comparatively high because of water in production.

TABLE 10-1—EXAMPLE ON WATER REQUIREMENTS

Number of producing units	2	4
Acres per unit	10	5
Feet between rows, d	1,320	660
Feet between wells, p = a	330	330
Distance ratio, d/a	4	2
Per-unit recoverable oil, thousand bbl.	400	200
Fluid factor	4	4
Volume factor	1.2	1.1
Per-unit dry-oil reserve, thousand bbl.	286	100
Total dry-oil recovery, thousand bbl.	572	400
Wet and marginal reserve, thousand bbl.	228	400
Produced water, million bbl.*	1.14	2.00
Injected water, million bbl.	2.10	2.86
Produced and injected water, million bbl.	3.24	4.86

*At 5 bbl. of water per barrel of wet and marginal reserve.

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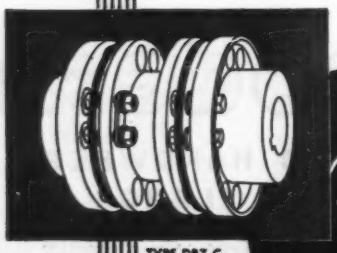

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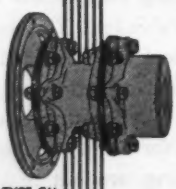

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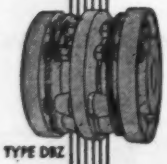

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Midget Aluminum Spudder

for drilling seismograph shot holes in Bahama Islands

by Paul Reed

THE lightest and probably the smallest cable-tool spudder ever built is being shipped to the Bahama Islands for the purpose of drilling seismograph shot holes. This spudder, weighing less than 2,400 lb., was designed and built by Shaffer Manufacturing Co. to meet the specifications of Seismograph Service Corp. which has procured it for an exploration program early this year undertaken for Anglo-Bahamian Petroleum Co.

A party of three is leaving for the Bahama Islands to prepare for operations which will be carried on by a total of five Americans and 40 or 50 nationals.

This spudder has been devised to meet the peculiar conditions encountered in the Bahama Islands, where trouble with lost circulation would be expected if rotary-type equipment were used for drilling hard coal and lime formations which are similar to those in southern Florida. In West Texas, Southwest Texas, and Oklahoma, where hard formations have required cable-tool instead of rotary shot-hole drilling, it has been customary to contract this work with contractors having spudder equipment of types commonly used for drilling shallow wells. Therefore seismograph organizations have not found it necessary to develop cable-tool equipment for such operations. Bahama problems required development of the midget spudder as a special solution.

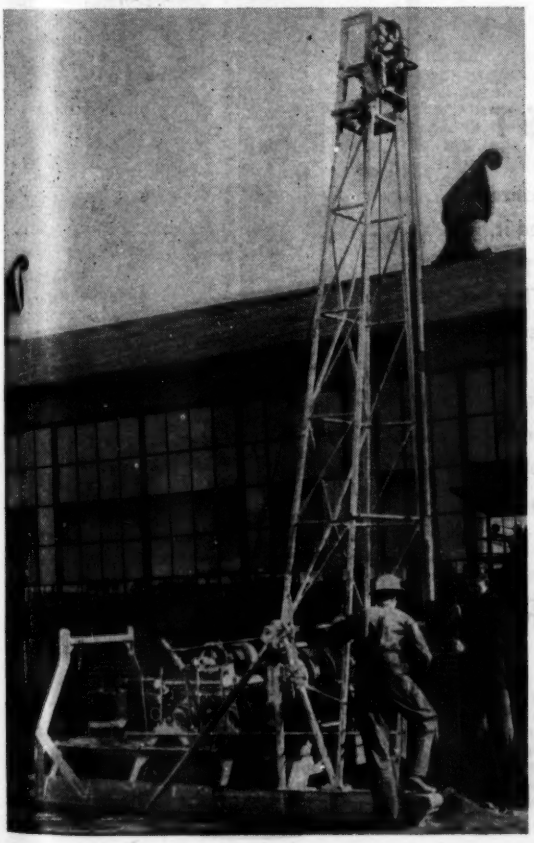
Active geophysical exploration is being conducted by American and British interests in the Bahama Islands area which has much significance because of its position on the continental shelf. Except in the area where a "deep" exists between the Bahamas and Florida it is anticipated that there will be an increasing amount of geophysical exploration on the islands, shoals and in shallow water of this region.

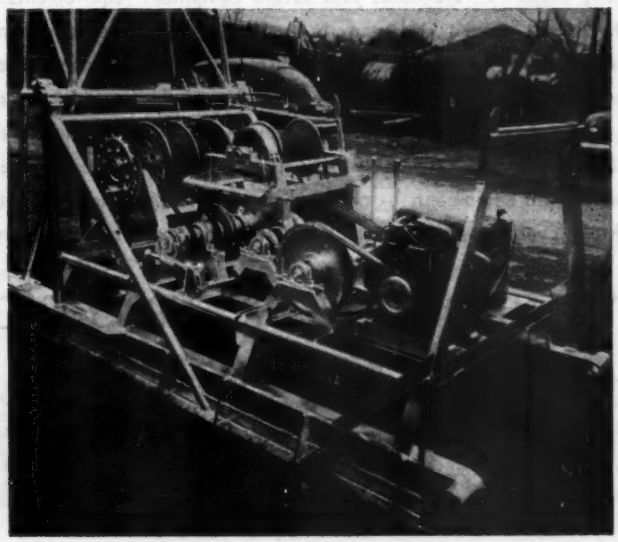
In designing this midget spudder, provision was made to facilitate transportation under cinditions characteristic of the Bahama coral islands where there are no roads and where there will be frequent occasions for transferring from boat to shore. Consequently the spudder has been built in eight units weighing from 150 to 350 lb. which may be readily assembled and bolted together. Furthermore, it is expected that the assembled spudder will be winched by its own power on and off a special steel-frame wagon equipped with both rubber and steel tires. In some situations the spudder will be winched on its own skids over the ground for short distances by means of wire line, snatch block and anchor post.

The spudder is equipped with a high-torque Onan engine, 6½-hp. at 1,500 r.p.m., 10-hp. at 3,000 r.p.m. The mast is 18 ft. high, with crown-block equipped with rubber shock absorbers. Although the spudder is intended for drilling only to depths of 200 ft., the bull drum is capable of holding 500 ft. of ½-in. cable, making it possible to drill to depths of several hundred feet. Standard steel cable tools for a 4½-in. hole are used. Dimensions at the skids are: width, 5 ft. 3 in.; length, 12 ft. 10 in.

All parts of the spudder unit are made of aluminum except the spudder frame, bull drum, engine, clutches, sprockets, chains, and bearings. Satisfactory operation is obtained without anchoring the skids.

This is believed to be the first spudder built for the particular requirements of coral island exploration operations. With the probability that extensive seismograph shooting will be done in the Bahamas and other coral island regions in the near future, it is likely that there may be a wide application for this equipment.





Left: Seismograph Service Corp. aluminum spudder drilling an experimental hole at a depth of 40 ft. near Shaffer Mfg. Co. shops. Below: Gasoline engine, drums, and skids of spudder built for Bahama Island service

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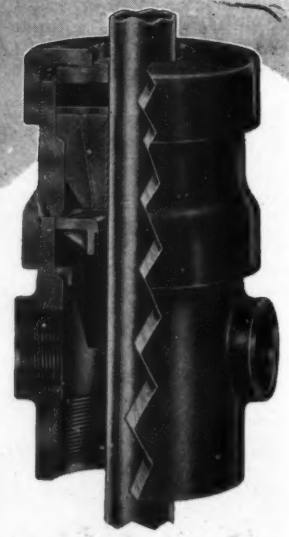

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QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Allowable Gum in Gasoline

In The Refiner's Notebook of September 29, 1945, you show gum contents of gasolines ranging from 6 to 50 mg. What is the basis for this and why are the specified gum contents below 10 mg.?—L. G.

IN The Refiner's Notebook No. 61, satisfactory performance is indicated at 6-10 mg. A.S.T.M. preformed gum, and this is what should be expected in specifications. Gum contents of 15-25 mg. can be tolerated during a few hours of operation or continuously for 1,000 miles or so but cannot be used regularly. Apparently conditions do not get much worse with 30-50 mg. of gum, perhaps because the deposits flake off and are ejected continuously from the engine. All of these conclusions are most general because they are influenced by the following conditions and generalizations about gum:

1. Only preformed or actual gum is significant (see Table 1 and Reference 1).

2. Potential or ultimate gum means little except as a measure of what can possibly happen in case of an error or accident in supplying a high gum gasoline.

3. A high manifold temperature greatly increases the intake valve and chamber deposits (Reference 2).

4. A rich mixture generally causes larger engine deposits. (Reference 2).

5. Time (or miles) of operation is significant, but miles of operation less than 10,000 would seem to be unworthy of consideration. Most motorists would like to avoid even one engine overhaul.

6. Deposits increase rapidly with gum content up to 7 or 10 mg. but a higher gum content has little effect. This is illustrated most emphatically by data from Reference 3 on stationary engines. The hours of satisfactory operation were somewhat as follows:

Mg. A.S.T.M. gum	Hours operation (six engines) Worst test	Approx. average*
1.5	425	485
7	160	320
10	170	340
25	140	300
50	75	300

*Approximate because many tests were stopped at 500 hours.

Table 1 is an attempt to summarize the gum findings of a number of experimentors.

References

1. Voorhees & Eisinger, Significance of Gum in Gasoline, The Oil and Gas Journal, Dec. 20, 1928, p. 152.
2. Marley, Martin & Gruse, Moderate Gum Content Gasoline not Harmful, The Oil and Gas Journal, Nov. 10, 1932, p. 12.
3. Alspaugh, M. S., Gasoline Gum Tolerance of Ordinance Equipment, Jour. S.A.E., p. 289, June 1946.
4. Hunn, Fischer & Blackwood, Gum in Gasoline . . ., N.P.N., Oct. 23, 1929, p. 65.
5. A.S.T.M. Committee D2 Report, 1932.

TABLE 1—SUMMARY OF ENGINE TESTS ON GUM CONTENT

Preformed gum or its approx. equiv., mg. per 100 ml.	Potential gum or its approx. equiv., mg. per 100 ml.	Results or comments	Reference
4	10	No deposits—short test	1
7	65	No deposits—short test	1
4	19	No deposits—short test	1
12	46	No deposits—short test	1
4	51	No deposits—short test	1
8	712	No deposits—short test	1
11	110	Slight deposits—short test	1
18	32	Trace on inlet valve—short test	1
12	453	More inside cylinder head—short test	1
6	351	No deposits, 1,068 miles	1
10	...	Satisfactory	4
10	...	Slight deposits, 4 vehicles	5
1.5	...	Exceptionally clean, 50° F., 5,000 miles	3
1.5-10	...	Tolerable, 70° F., 10,000 miles	3
1.5	...	Stationary engines, 500 hours	3
22	188	Some deposits—short test	1
17	237	Some deposits—short test	1
18	32	Some deposits—short test	1
25	...	Trouble and deposits at 4,000 miles	4
20	...	Deposits 4 cars, valve sticking 2 cars	5
39	69	Considerable deposits in cylinder head	1
26	81	Considerable deposits in cylinder head	1
10-25	...	Slight deposits at 50° F. and 5,000 miles	3
10-50	...	Satisfactory to 5,000 miles, trouble past 5,000 miles	3
7-50	...	Stationary engines, only 75-300 hours	3
120	665	Valve sticking—17¼ hours	1

Does Sulfuric Acid Act as Solvent?

Is the action of sulfuric acid that of a solvent? What about lubricating-oil treating?—L. F. R.

A direct answer is difficult because sulfuric acid acts differently on various materials and because there are various ways in which the term "solvent" can be employed. Probably in no instance can the solvent action of sulfuric acid be considered as the same as that of the solvents used in such processes as sulfur dioxide, furfural, phenol, or chlorex extraction processes. A short summary of the reactions of sulfuric acid is given in Chapter 24 of Petroleum Refinery Engineering (McGraw-Hill Book Co., Inc., New York) and a complete discussion appears in Chapter 2 of Chemical Refining of Petroleum by Kalichevsky & Stagner, Reinhold Publishing Corp., New York.

The question is somewhat academic because even if its action on one kind of compound were that of a solvent, it would probably be reacting chemically with other compounds at the same time. Not much can be done about the situation in the plant, and in the laboratory it is difficult to distinguish between chemical and physical actions. Thus, although the acid may remove certain materials by its solvent action, the acid may then react with the dissolved materials in a truly chemical fashion. There is some indication of this in the fact that acid sludge tends to generate heat, become more viscous, and even solidify to a coke-like mass as time elapses.

S. F. Birch in Volume 3 of Science of Petroleum (Oxford University Press, London) states that the action of sulfuric acid is mainly that of a solvent with regard to such sulfur compounds as sulfides, sulfoxides, sulfones, and thiophen but that it neither dissolves or reacts with free sulfur or carbon disulfide. Hydrogen sulfide is oxidized. Although sulfuric acid does react slowly with paraffin, naphthene, and aromatic compounds, no very definite or vigorous action occurs until the olefins are considered. Asphaltic materials are variously referred to as being dissolved, adsorbed, or precipitated. Chemical reactions do occur within the sludge after it has been separated. Kalichevsky and Stagner state that soft asphalt is dissolved and that hard asphalt is irreversibly flocculated or coagulated but with accompanying oxidation reactions. With respect to White or medicinal oils, Gruse and Stevens in Chemical Technology of Petroleum (McGraw-Hill Book Co., Inc., New York) feel that the action of sulfuric acid is apparently one of reacting with the unstable compounds, followed by dissolving of compounds of intermediate character.

Gas Conservation in West Texas

(Continued from page 77)

the United States as compared to 10 billion barrels of gasoline from our presently known oil reserves of 20 billion barrels.*

Increased utilization of West Texas gas should result in a higher price for the gas—all of which does not favor the carbon-black manufacture in a competitive gas market. Greatly increased efficiency in treating sour gas for only a fraction of a cent per thousand cubic feet has virtually removed any objections to its use for light and fuel.

The allotting of West Texas sour gas for the manufacture of carbon black was begun at a time when there was no other market, and it was done merely to provide West Texas property owners with some outlet for their gas. That day has passed, and with available markets ready to pay from 4 to 6 cents per thousand cubic feet, the property owners are clamoring for carbon-black manufacturers to be put on an equal basis with other buyers. There is no objection to manufacturing carbon black, but it is thought that the gas should go to the highest bidder—thereby throwing carbon black into competition with other buyers of gas.

Summary

Summarizing my views on gas conservation in West Texas—and for that matter in other oil and gas regions, I should like to make the following predictions:

1. The matter of achieving sound oil and gas operation includes gas conservation. Many problems are involved, some of which have been solved but many of which remain to be solved—even beyond this generation. Of necessity these problems must meet the rigid requirements of economic conservation. That is, the gas which accompanies oil production or is intimately related to oil production, as in the case of an associated gas cap, must be utilized in a manner that will first permit the maximum economic recovery of all hydrocarbons contained in a reservoir. The remaining gaseous hydrocarbons can then be utilized for fuel and manufacturing purposes.

2. The industry, confronted with an ever-increasing demand for its products and coupled with more expensive and ever deeper drilling, will make it mandatory for the industry to seek and attain the maximum recovery of all types of hydrocarbons. This condition requires efficiency. Efficiency is not possible without conservation; and conversely, conservation assists the industry in fulfilling its obligation to itself, its employes, the consumer, and the nation. A high standard of living demands efficiency in all phases of this and other industries.

National defense, should it be needed, demands preparedness and capacity of the oil and gas industry.

3. Those of us engaged in the producing phase of the industry, and those of you who contemplate such connection, must always bear in mind that in spite of the problems and handicaps which have been solved and overcome—many remain to be attended.

4. The line of demarcation between oil production and gas production grows less sharp. There was a time when you were either in the oil business or in the gas business. Those were truly "single horse" businesses; now it is a team of horses, of the same color, because we are now concerned with hydrocarbons in place of a liquid and a gas. We have learned to utilize hydrocarbon molecules to a greater extent regardless of their crude physical state.

In conclusion, conservation "boiled down," amounts to what some people call "shrewdness" and to what some people call "common sense."

And finally, you may ask, what part do you as future members of the industry's technical profession play in this all-important and highly interesting oil and gas business? Simply this: Your futures are the same.

Acknowledgment

John R. Coombs, Phillip Davis, W. H. Speaker and numerous other employes of Magnolia Petroleum Co., Dallas; Jack K. Baumel and Sol Smith, Texas Railroad Commission, Austin; Gordon Fisher and T. W. Rhodes, Gulf Oil Corp., Fort Worth, and W. F. Matheny, Phillips Petroleum Co., Bartlesville.

*Wall Street Journal, Vol. 128, No. 130 (12-2-46), Oxygen Steps Out—Sydney B. Self.

TABLE 7—ESTIMATED OIL WELL GAS PRODUCTION AND DISPOSITION, OCTOBER 1946, DISTRICTS 7-C AND 8, WEST TEXAS

	Daily avg. M.M.c.f.	Per cent total
Production of oil well gas*	500	100.0
Total gas processed	333	66.6
Ultimate disposition of gas:		
Extraction loss	16	3.2
Pipe line	14	2.8
Plant fuel, drilling and lease operation	73	14.6
Gas lift	34	6.8
Carbon-black manufacture	96	19.2
Recycling	0	0.0
Repressuring	9	1.8
Vented and line loss†	258	51.6

*Computed by multiplying daily average oil production for October 1946 times assumed gas-oil ratio of 900 cu. ft. per bbl. (Assumed state-wide gas-oil ratio for 1945, 1,350 cu. ft. per bbl.) †Represents difference between estimated total gas production and reported disposition figures from Texas Railroad Commission.

Benton Unit

(Continued from page 58)

The pressures measured in all four wells corrected to a common subsea base of —7,750 ft. varied from 3,674 to 3,679 psi., which within the accuracy of the instruments employed, amounted to identical pressures. This showed that withdrawals from No. 1 well had resulted in a rapid and uniform pressure drop of about 66 psi. throughout the "D" sand reservoir. While it has not been possible to make similar studies on the Bodcaw sand, its characteristics of continuity, high permeability, and high porosity indicate that it will show pressure equalization similar to that in the "D" sand.

Pressure Maintenance Plan

The operator plans to cycle by sweeping the reservoirs from southeast to northwest. Originally No. 10 well and possibly No. 3 will be used as input wells to the "D" sand, while withdrawals will be made from wells in the northwest section of the field. In the Bodcaw sand, less choice of wells is possible at present, although additional wells may be completed in that reservoir to afford more efficient displacement. Possible Bodcaw input wells are Nos. 3, 4, and 13, and wells No. 1, 6, and 15 may be used for withdrawals.

Consideration has been given to the possibility of using water to implement the pressure maintenance by dry gas. This added input will provide makeup for the shrinkage of processed gas and will afford added liquid recovery from gas by maintaining reservoir pressures at or near their initial points. Nonproductive wells on the flanks of the structure may be utilized for this purpose.

No evidence of water exists in either reservoir, since pressures declined even with limited withdrawals. At the original reservoir pressure of 3,745 psi. at 8,000 ft. in the "D" sand, "liquid" recovery is calculated from the laboratory tests on recombined samples to equal 71.5 bbl. per million cubic feet.

With pressure maintenance it is estimated that 91 per cent of liquids in place in the reservoirs may be recovered, whereas the pressure-depletion method of production would net only 57 per cent of liquid reserves. The added recovery expected through unitized cycling operations amounts to more than 5,000,000 bbl. of liquid products valued in excess of $6,000,000.

Much of the individual credit for the initiation and planning of the unitization project and carrying it through to a successful conclusion has been given D. R. Snow, executive vice president in charge of all operations for Barnsdall Oil Co. outside the West Coast.

modern Rotary drilling

Basic Considerations

DISCUSSION of a subject as vast as the method of rotary drilling of oil wells requires systematic arrangement of data, if the clarity and continuity of the review is to be maintained. A summary of basic considerations, leading toward classification of equipment and of stages of drilling progress, is therefore advisable.

Basic Principles

From the point of view of actual drilling only, the equipment of a rotary rig must perform following functions:

A bit, of design best suited for cutting, scraping, or crushing of the formations to be penetrated, must be placed at the bottom of the hole and must be withdrawn when it becomes dull. Rotating motion must be imparted to the bit, and weight placed upon it. These two factors, rotation and weight, result in the hole-making action of the bit. Means must be provided for removal of the cuttings from the hole. Power must be furnished for performance of the above operations.

As far as drilling alone is concerned these are the only operations required. Incidental, of course, is setting of surface, and in some cases of intermediate, strings of casing. The purpose of drilling an oil well, however, is to complete the well as a producer or, in the case the well is dry, to secure as much information as possible on the formations penetrated by the hole. Therefore, the following operations are also an integral part of rotary oil well drilling.

To complete a well as a producer, production string of casing must be set, casing must be cemented, and suitable bottom-hole and surface equipment must be installed.

Securing of information on the formations drilled is accomplished in either one of the three possible ways: (1) By securing actual samples of formations through conventional, wire-line, or side-wall coring; (2) by special well-logging methods, such as electrical, radioactivity, mud analysis, rate of penetration, caliper, and temperature logging; (3) by determination of the probable productivity of formation through drill-stem testing.

Classification of Equipment

The most logical classification of equipment is according to the purpose for which it has been designed. Considering the basic principles, outlined above, the equipment of a rotary rig may be divided into certain groups. It must be noted, of course, that some of the equipment has more than one function to perform; it may, therefore, belong to more than one group.

Hoisting equipment would include derrick, together with substructure and foundations, draw works, crown and traveling blocks, elevators, wire rope, and other miscellaneous equipment such as rotary slips, tongs, etc.

Rotating equipment would include draw works, rotary chain, rotary table, kelly joint, drill pipe.

Circulating equipment is a portion of the circulating system which is composed of circulating equipment, system of pits and ditches, and rotary mud.

The equipment consists of pumps, drilling hose, swivel, kelly joint, drill pipe, shale shaker, chemical tanks, and necessary connections.

System of pits furnishes space for separation of cuttings from the mud and for immediate and reserve supply of the rotary mud. Ditches form the connecting passages. The annulus of the drilled hole, between the walls of the well and the drill pipe, must be considered a portion of this system.

Rotary mud, besides the primary function of removing the cuttings from the hole, serves also as a medium for plastering the walls of the hole, sealing of gas and water-bearing horizons, cooling and lubricating the bit, and aiding the bit, through jetting action, in making of hole in soft formations.

Hole-cutting equipment includes rotary bits of different types and designs.

Power equipment includes all the equipment needed for generation and application of power.

Miscellaneous equipment. To this group belongs all the equipment, tools, machinery, and instruments not belonging to any of the abovementioned groups and essential to the operation of a rotary rig.

Classification of Rigs

There are several possible ways of classifying rotary rigs. The one most generally accepted is from the standpoint of the type of power used. Under this classification rotary rigs are divided into four groups as follows: (1) Steam rigs, (2) internal-combustion-engine, mechanical-drive rigs. These are the rigs in which internal-combustion engines are used as prime movers, and chains, V-belt drives, or gears are used as means of transmitting power. (3) Internal-combustion engine—d.c. electric-drive rigs, with generators driven by internal-combustion engines. (4) Electric-drive rigs, using a.c. purchased power.

From the point of view of chronology of progress and for the purposes of this series, the operations of rotary drilling of an oil well may be divided into four general groups, as follows: rigging up, drilling, completion, and dismantling of the rig.

Rigging up.—Under above broad classification rigging up must include not only actual assembling of tools and machinery but also several preparatory operations, such as building of roads to location, clearing and preparing the location, and erecting the derrick.

Drilling.—Actual drilling may be divided into two distinctive phases. The first phase includes drilling to and including setting and cementing of surface pipe.

The second phase includes routine drilling from setting of surface pipe to, but not including, setting of the production string. In some cases this phase may include setting of intermediate strings of casing. It always does include operations having as its purpose determination of characteristics of formations penetrated by the hole.

Completion.—This phase includes setting and cementing of the production string of casing and all operations of actual completion of the well. If the completion is not satisfactory and the well is to be deepened, the operations from the time new hole is started until the second completion, or abandonment, are included again under drilling. If the completion is not satisfactory and upper horizons are to be tested, each test is a separate completion.

Dismantling the rig.—Besides actual dismantling of machinery this phase includes also moving the rig away from the location.

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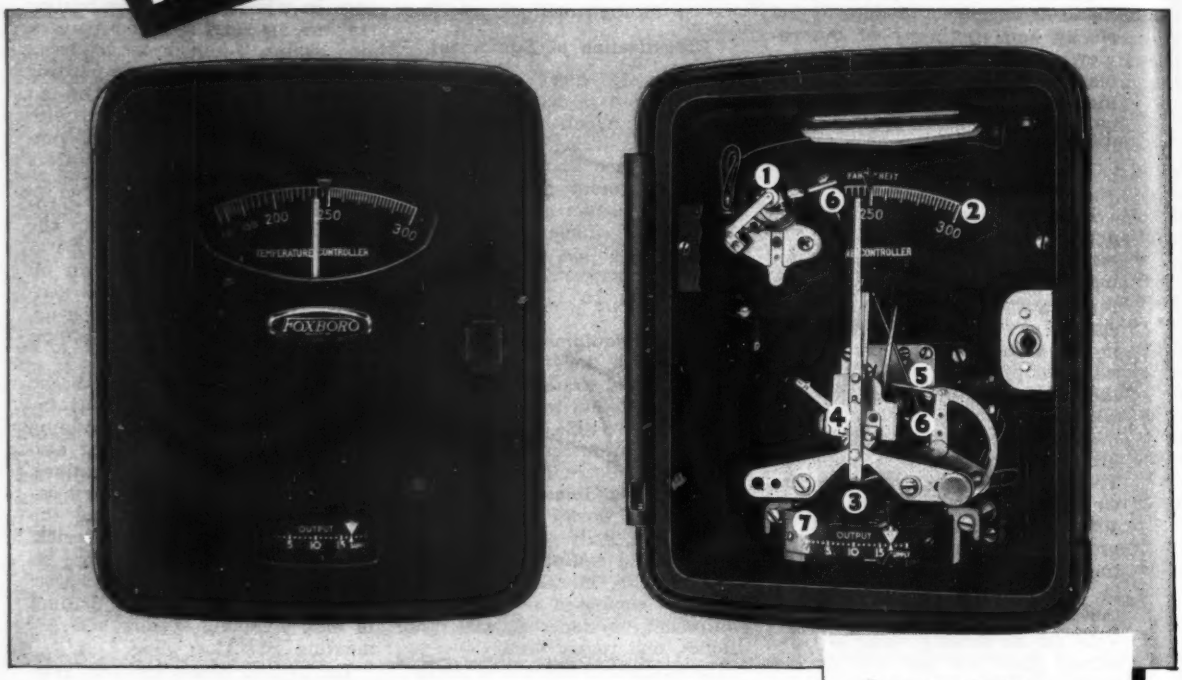

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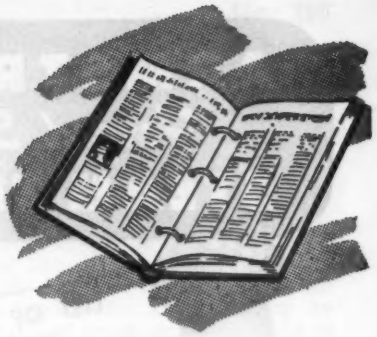
The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL



50°-100° A.P.I. Versus Specific Gravity

Degrees A.P.I.	Tenths of degrees									
	0	1	2	3	4	5	6	7	8	9
50	.7796	.7792	.7788	.7783	.7779	.7775	.7770	.7766	.7762	.7758
51	.7753	.7749	.7745	.7741	.7736	.7732	.7728	.7724	.7720	.7715
52	.7711	.7707	.7703	.7699	.7694	.7690	.7686	.7682	.7678	.7674
53	.7669	.7665	.7661	.7657	.7653	.7649	.7645	.7640	.7636	.7632
54	.7628	.7624	.7620	.7616	.7612	.7608	.7603	.7599	.7595	.7591
55	.7587	.7583	.7579	.7575	.7571	.7567	.7563	.7559	.7555	.7551
56	.7547	.7543	.7539	.7535	.7531	.7527	.7523	.1519	.7515	.7511
57	.7507	.7503	.7499	.7495	.7491	.7487	.7483	.7479	.7475	.7471
58	.7467	.7463	.7459	.7455	.7451	.7447	.7443	.7440	.7436	.7432
59	.7428	.7424	.7420	.7416	.7412	.7408	.7405	.7401	.7397	.7393
60	.7389	.7385	.7381	.7377	.7374	.7370	.7366	.7362	.7358	.7354
61	.7351	.7347	.7343	.7339	.7335	.7332	.7328	.7324	.7320	.7316
62	.7313	.7309	.7305	.7301	.7298	.7294	.7290	.7286	.7283	.7279
63	.7275	.7271	.7268	.7264	.7260	.7256	.7253	.7249	.7245	.7242
64	.7238	.7234	.7230	.7227	.7223	.7219	.7216	.7212	.7208	.7205
65	.7201	.7197	.7194	.7190	.7186	.7183	.7179	.7175	.7172	.7168
66	.7165	.7161	.7157	.7154	.7150	.7146	.7143	.7139	.7136	.7132
67	.7128	.7125	.7121	.7118	.7114	.7111	.7107	.7103	.7100	.7096
68	.7093	.7089	.7086	.7082	.7079	.7075	.7071	.7068	.7064	.7061
69	.7057	.7054	.7050	.7047	.7043	.7040	.7036	.7033	.7029	.7026
70	.7022	.7019	.7015	.7012	.7008	.7005	.7001	.6998	.6995	.6991
71	.6988	.6984	.6981	.6977	.6974	.6970	.6967	.6964	.6960	.6957
72	.6953	.6950	.6946	.6943	.6940	.6936	.6933	.6929	.6926	.6923
73	.6919	.6916	.6913	.6909	.6906	.6902	.6899	.6899	.6892	.6889
74	.6886	.6882	.6879	.6876	.6872	.6869	.6866	.6862	.6859	.6856
75	.6852	.6849	.6846	.6842	.6839	.6836	.6832	.6829	.6826	.6823
76	.6819	.6816	.6813	.6809	.6806	.6803	.6800	.6796	.6793	.6790
77	.6787	.6783	.6780	.6777	.6774	.6770	.6767	.6764	.6761	.6757
78	.6754	.6751	.6748	.6745	.6741	.6738	.6735	.6732	.6728	.6725
79	.6722	.6719	.6716	.6713	.6709	.6706	.6703	.6700	.6697	.6693
80	.6690	.6687	.6684	.6681	.6678	.6675	.6671	.6668	.6665	.6662
81	.6659	.6656	.6653	.6649	.6646	.6643	.6640	.6637	.6634	.6631
82	.6628	.6625	.6621	.6618	.6615	.6612	.6609	.6606	.6603	.6600
83	.6597	.6594	.6591	.6588	.6584	.6581	.6578	.6575	.6572	.6569
84	.6566	.6563	.6560	.6557	.6554	.6551	.6548	.6545	.6542	.6539
85	.6536	.6533	.6530	.6527	.6524	.6521	.6518	.6515	.6512	.6509
86	.6506	.6503	.6500	.6497	.6494	.6491	.6488	.6485	.6482	.6479
87	.6476	.6473	.6470	.6467	.6464	.6461	.6458	.6455	.6452	.6449
88	.6446	.6444	.6441	.6438	.6435	.6432	.6429	.6426	.6423	.6420
89	.6417	.6414	.6411	.6409	.6406	.6403	.6400	.6397	.6394	.6391
90	.6388	.6385	.6382	.6380	.6377	.6374	.6371	.6368	.6365	.6362
91	.6360	.6357	.6354	.6351	.6348	.6345	.6342	.6340	.6337	.6334
92	.6331	.6328	.6325	.6323	.6320	.6317	.6314	.6311	.6309	.6306
93	.6303	.6300	.6297	.6294	.6292	.6289	.6286	.6283	.6281	.6278
94	.6275	.6272	.6269	.6267	.6264	.6261	.6258	.6256	.6253	.6250
95	.6247	.6244	.6242	.6239	.6236	.6233	.6231	.6228	.6225	.6223
96	.6220	.6217	.6214	.6212	.6209	.6206	.6203	.6201	.6198	.6195
97	.6193	.6190	.6187	.6184	.6182	.6179	.6176	.6174	.6171	.6168
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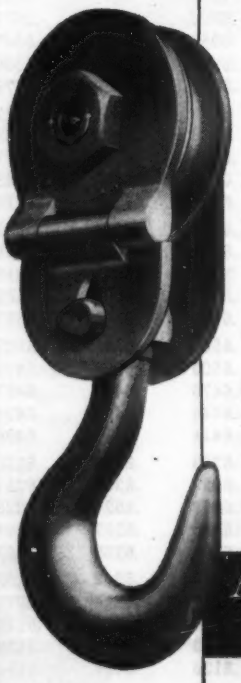

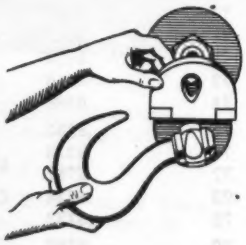

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ENGINEERING fundamentals

A FEATURE OF THE OIL AND GAS JOURNAL

No. 268

Deaeration of Water

MECHANICAL deaeration, as applied to boiler feed water, is the removal of dissolved gases such as oxygen, carbon dioxide, and ammonia by the process of raising the water to the saturation temperature for the pressure under which the process is conducted; employing an equipment design that secures intimate mixture of the water and the scrubbing steam; and providing means for the liberal venting from the system of the gases released.

Use or Purpose

Necessity for removing these corrosive gases from boiler feed water in order to prevent corrosion is now fully recognized. Dissolved oxygen will cause pitting and corrosion of boiler feed lines, closed heaters, economizers, boilers, steam, and return lines. If carbon dioxide is also present, the two gases acting simultaneously may be considered from 10 to 40 per cent more corrosive than would be expected for the same quantity of the two gases acting individually.

It has been determined that oxygen is relatively 5 to 10 times more corrosive than equal quantites of carbon dioxide, and that temperature is also an important factor. Where corrosion is caused largely by carbon dioxide, the structure and composition of the steel are factors in determining its life.

The mechanism of gas removal from water through the use of the scrubbing action of the vapor (steam) of the solvent (water) involves two separate mechanisms as follows:

1. Mechanical separation of gas bubbles results when saturation conditions are achieved and when the vapor pressure of the liquid solvent and the solution pressure of dissolved gases appreciably exceed the pressure imposed on the system. Under these conditions, all gases become insoluble. However, saturation conditions alone do not assure complete gas removal. If only saturation conditions were necessary for gas removal, there would be no need for the complicated tray or jet design of feedwater heaters, since an open tank, filled with water at 212° F. at atmospheric pressure, would accomplish complete deaeration.

2. Diffusion of gas particles to the surrounding atmosphere (without bubble formation) results when the total internal pressure of the liquid solvent and dissolved gases is less than or slightly more than the pressure imposed on the system. Ammonia removal, because of the extreme solubility of this gas, must be accomplished by diffusion rather than mechanical separation.

In the removal of dissolved oxygen from water, 90 to 95 per cent of the initial oxygen content will leave the water immediately and without difficulty by mechanical separation when the water is heated to the saturation temperature for the pressure imposed on the system. The remaining 5 to 10 per cent of the initial oxygen content must be removed through molecular diffusion. In ridding the system of this last 5 to 10 per cent of the initial oxygen content, it is obvious that the rapidity of oxygen removal will be a function of the heater design and also of the rapidity with which the surrounding atmosphere is changed and gases vented from the system.

The conventional-type open heater is not as efficient in the removal of oxygen and carbon dioxide as is a deaerating unit. With deaerating units, extra factors of safety are incorporated in the design and a vent condenser is employed so that a liberal amount of steam may be vented from the heater without heat waste. Ordinary open heaters are not usually designed to provide as intimate mixture of steam and water and as efficient venting as is required for more complete deaeration.

This material is from the Betz Handbook for Industrial Water Conditioning, written and published by W. H. and L. D. Betz, consulting engineers, Philadelphia.

The standards of the Heat Exchange Institute define a deaerating heater as an equipment for heating water by means of steam, designed so as to insure the removal from the water of the dissolved oxygen in excess of 0.03 cc. per liter.

A deaerator is defined as an equipment for heating water by means of steam and designed so as to insure the removal from the water of the dissolved oxygen in excess of 0.005 cc. per liter.

There are two principal types of deaerating heaters—the tray type and the jet atomizing type. The tray-type deaerating heater spreads out the water in thin films by means of baffles or trays so as to insure intimate contact of the steam with the water and to provide thorough agitation. In addition, a relatively large amount of steam is vented from the unit, passing to the vent condenser where the steam is condensed and returned to the heater while the noncondensable gases are discharged to the atmosphere. The flow of steam may be counterflow to the water flow or parallel flow may be employed. Satisfactory deaeration is obtained with each design.

In the jet atomizing deaerator the water is sprayed into a steam atmosphere and thereby heated to within 2° to 3° F. of the steam temperature. This operation removes 90 to 95 per cent of the oxygen. The water is then delivered into a high-velocity steam jet and the water is broken up, or atomized, by the action of the steam jet securing complete deaeration in this operation. Steam flow is countercurrent to waterflow. As in a tray-type heater, the gases are passed through a vent condenser and the condensate returned to the heater.

The atomizing deaerator, while subject to a 0.5 lb. pressure drop across the nozzle, is especially suited to handling turbid waters and those of high carbonate hardness which would tend to plug the trays in a tray type unit.

Where desirable to deaerate water at temperatures below the atmospheric boiling point of water the water may be sprayed or passed over trays in a unit under vacuum. These units are not designed for complete deaeration inasmuch as the size and cost of the apparatus increase sharply for the removal of the last traces of oxygen. Oxygen content has been reduced to 0.25 cc. per liter with the maintenance of a 28.5 in. vacuum.

Natural Gasoline

October Light Products Output at Record Level

PRODUCTION of natural gasoline and other light products in October 1946 reached a new record level, rising 12 per cent above October 1945 and 4 per cent above the preceding month as a result of unusually heavy demand in the peak consuming season.

The monthly report of the U. S. Bureau of Mines listed daily average output of light fractions at 13,718,000 gal. against 13,194,000 gal. the preceding month. Of the separate products in the classification, commercial butane-propane mixture showed a sharp increase from a total of 30,933,000 gal. during September 1946 to 40,444,000 gal. in October.

A continued rise in production of natural gasoline alone in November 1946 was indicated in the monthly report of the Natural Gasoline Association of America. This report, covering Mid-Continent and Gulf Coast areas, placed daily-average production during November at 4,949,898 gal. against 4,887,037 gal. in October —all on the basis of the equivalent to the 26-70 grade.

The N.G.A.A. report for November showed gains in natural-gasoline production in New Mexico and Louisiana more than offset drops in output in Oklahoma and Texas, the major producing states. Louisiana daily-average production, figured on the basis of the 26-70 equivalent, gained from 274,892 gal. in October to 298,978 gal. in November; and New Mexico from 246,388 gal. to 448,560 gal., while Oklahoma dropped from 902,881 gal. to 749,262 gal., and Texas from 3,034,477 gal. to 3,014,954 gal.

The Bureau of Mines summary of production, stocks, and demand for all light products during October reported gains in nearly all producing states lifted daily-average production 1 per cent above the former record high in February 1946. Total output in Texas during the month was 202,437,000 gal. against 194,579,000 gal. in September 1946; Louisiana production rose from 43,480,000 gal. to 48,257,000 gal., and Oklahoma from 34,148,000 gal. to 37,095,000 gal.

The increased production was accompanied by a drop in stocks, the bureau report noted. Stocks at refineries fell from 90,594,000 gal. September 30 to 77,028,000 gal. October 31; stocks at plants and terminals dropped from 205,914,000 to 188,061,000 gal. in the same period.

At the end of the month, total stocks of 265,098,000 gal. included 185,165,000 gal. of natural gasoline, 41,132,000 gal. of L.P.G., and 38,792,000 of other products. Over-all demand for all light products was up from 404,355,000 gal. in September to 451,587,000 in October.

Harts to Head N.G.A.A. Convention Committee

H. W. Harts, vice president of Warren Petroleum Corp., Tulsa, will head the 1947 convention program committee of the Natural Gasoline Association of America, according to a recent announcement of William F. Lowe, N.G.A.A. secretary. The convention is to be held April 23-25 in the Baker Hotel, Dallas.

Others appointed to serve on this committee by N.G.A.A. President J. H. Dunn, Shamrock Oil & Gas Corp., Amarillo, include: W. L. Bowser, Atlantic Refining Co., Dallas; F. B. Haverfield, Continental Oil Co., Ponca City; Max Lents, J. S. Abercrombie Co., Houston; James E. Pew, Sun Oil Co., Philadelphia; W. H. Vaughan, Tide Water Associated Oil Co., Houston, and C. R. Williams, Chicago Corp., Corpus Christi.

Dunn stated elaborate plans have already been made to make the technical sessions of the convention as complete as possible. "During the war years some of the usual technical committee studies had to be curtailed in the interest of the general war effort," he said. "These committees are now working steadily on problems of benefit to both the natural-gasoline and cycling industries, and the program will be filled with these valuable reports and discussions."

Natural Gas News

New Denver-Cheyenne Gas Line to Be Built

DENVER, Colo.—A 105-mile natural-gas pipe line from Denver to Cheyenne, Wyo., will be built this spring by Colorado-Wyoming Gas Co. The new line, to cost in excess of $1,500,000, will connect near Denver with a new line bringing gas from Hugoton field in Kansas.

Company officials said plans for the new line await final approval of the Federal Power Commission. Construction is scheduled to begin April 1 and will require an estimated 8 months.

In Cheyenne, H. H. Lenhart, general manager of Cheyenne Light, Fuel & Power Co., said his firm will spend approximately $305,000 for necessary interconnections between the new line and the existing system and for extensions to the present distribution system.

Decision to use gas from the Kansas field, he said, followed a survey of Wyoming gas fields which indicated only a 15 to 17-year supply. The new line, he said, will triple the amount of gas available to Cheyenne, which experienced a critical shortage during recent cold weather.

Lenhart said the number of natural-gas consumers increased 30 per cent during 1946. Conversion to natural gas by coal-burning consumers following the recent strike also has added to the supply problem, he added. Delivery of pipe for the new line early this year has been assured, Lenhart said.

The new line will be designed to carry a pressure of 1,000 psi., compared to maximum of 475 psi. in the existing line. It will connect with the new gas line about 8 miles east of Denver, run north through Greeley and connect with the present line southeast of Cheyenne. A compressor station will be built near the south terminal of the new line.

East Ohio Gas Rehearing Reset for February 19

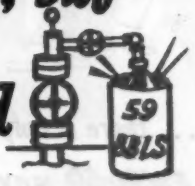
WASHINGTON.—At the request of the Public Utilities Commission of Ohio and East Ohio Gas Co., the Federal Power Commission has postponed until February 19 rehearing in connection with an FPC order of June 25, 1946, which found East Ohio to be a natural-gas company and subject to the FPC's jurisdiction.

The rehearing, granted at the request of East Ohio, has been limited to oral argument by parties who previously appeared in the proceedings. These include East Ohio, FPC staff representatives, the Public Utilities Commission of Ohio, and the cities of Cleveland, Lakewood, and Euclid, Ohio.

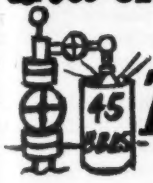
Hewitt No. 2 Was a Gauger's Dilemma

(an authentic case)

The "allowable" was 48 bbls. daily, but on a 7/64" choke the well over-produced



and on the next smaller size, 6/64", it under-produced.



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REFINING

McCarthy Plans Chemical Plant at Winnie, Texas

GLENN H. McCARTHY, Houston operator, has announced plans for the construction of a chemical plant at Winnie, Tex., which will produce aromatic and unsaturated hydrocarbon chemicals, including benzene and styrene.

The plant will be built by McCarthy Chemical Co. which was incorporated in October with McCarthy as president. According to the announcement made by McCarthy in Houston, the first unit for the plant will cost in excess of $3,000,000. McCarthy already operates a natural-gasoline plant at Winnie, which is located in Chambers County.

Additional units for the processing of petroleum and natural-gas hydrocarbons into chemical products are to be installed later. McCarthy recently made an offer of $9,100,000 for the U. S.-owned styrene plant in Texas City.

Other officers of the chemical company include Frank B. Champion, vice president and treasurer; G. M. McGranahan, vice president and general manager, and A. G. McNeese, Jr., secretary.

In his announcement of plans for the new plant at Winnie, McCarthy said:

"Houston is destined to become the chemical center of the United States. With our enormous reserves of natural gas, crude oil, and sulfur and with our deep-water ship channel, rail facilities and international air gateway, the chemical industry has found this part of our state the most desirable location in the United States for widespread chemical development.

"From conversations I have had with chemical companies, I know that plans already have been made and approved for expansion and new plants aggregating more than $300,000,000 to be completed within this area.

"The surface hardly has been scratched in plastic manufacturing. More and more chemical production will stimulate the production of plastics and other allied products, such as synthetic rubber, synthetic textiles, sulfur derivatives, and many other byproducts of chemicals."

Santa Fe Receives Six New Diesel Locomotives

CHICAGO.—Six of the new 1,500-hp. diesel locomotives which will pull high-speed passenger trains have been delivered to the Santa Fe railroad by Electro-Motive division of General Motors Corp. The new locomotives, adaptable for either freight or passenger service, will pull long Pullman trains at 100 m.p.h. or with a simple adjustment will perform as a heavy freight locomotive for mountain terrain with a speed up to 65 m.p.h.

The new F-3 locomotives have 150 hp. more than preceding models built by Electro-Motive. Most of their engine parts are interchangeable with those of previous equipment.

Trinidad Leaseholds, Ltd., Buys Ontario Refinery

TORONTO, Ont.—Goodrich Refinery Co. of Toronto and Port Credit, Ont., has been purchased by S. J. Vos, of London, England, for Trinidad Leaseholds, Ltd.

The Goodrich company, established 12 years ago, has a refinery at Port Credit with crude capacity rated at 5,000 bbl. daily and 2,000 bbl. daily cracking capacity. It has 120 service stations in Ontario.

The purchasers will continue the Port Credit plant as an integral unit of their company, shipping either crude or petroleum products from Trinidad, according to immediate requirements. R. Rosefield, founder of the Goodrich company, will remain as associate managing director in

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charge of marketing and sales, and C. G. Johnstone, of London, England, will be president and associate managing director. *(See the International News Section, page 44, for information on plans of Trinidad Leaseholds, Ltd.)*

Third-Quarter Refining Sales Gain 9 Per Cent

Sales by the oil-refining industry during the third quarter of 1946 increased 9 per cent over the second quarter, according to a survey of the Securities and Exchange Commission. Refining-industry sales totaled $1,936,636,000 during the period. For industry as a whole, the SEC report listed 1,169 corporations with third-quarter sales of $18,151,785,000—an over-all increase of 8.8 per cent over the preceding quarter.

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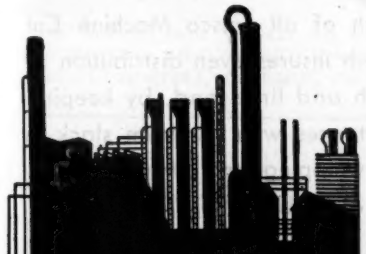

We design and construct all types of modern refining units.
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Tulsa Oklahoma

Enjay Will Market Standard Products

A new concern, Enjay Co., Inc., has been organized to handle the sale and distribution of all products of the chemical-products department of Stanco Distributors, Inc., and Standard Alcohol Co. The new company is a subsidiary of Standard Oil Co. (N. J.) Enjay will handle domestic and foreign marketing of the various products, which are based on synthetic chemicals derived from petroleum.

Officers of the new company are: H. W. Fisher, president; John A. Britton, Jr., and James G. Park, vice presidents; W. F. Quick, secretary; H. P. Schoeck, treasurer; G. M. Buckingham, assistant secretary; and L. R. Moore, assistant treasurer.

Diesel Developments Of Germans Published

Wartime developments in design and performance of German diesel engines and accessories are contained in a 322-page British report now offered for sale by the Office of Technical Services of the Department of Commerce.

Included in the developments are a two-stage method for supercharging submarine engines, a new fuel-injection pump, ceramic-piston experiments, a novel strain gage, and an experimental diesel-airplane engine.

Other reports now on sale by the technical services office include one on "derminols," a group of German synthetic fat substitutes for use in treating leather, and another on an automatic heat-treating process which facilitates the flash welding of hard-drawn, high-carbon steel wire and recent experiments on the mechanical properties of certain steels in connection with heat-treating hardenability.

WAA Refinery Sale Nets Government $106,641

HOUSTON. — Standard Oil Development Co. was the major purchaser of government-owned hydrogenation equipment at the Humble Oil & Refining Co. refinery at Baytown, Tex., in a War Assets Administration sale that brought the Government $106,641.

Standard Oil Development paid $102,070 for the bulk of the equipment which consisted of tanks and accumulators, heat exchangers, pumps, and compressors. Humble bought a back-pressure-regulating assembly for $3,371 and a sewerage system serving the plant site, which is on Humble property, for $1,200.

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PIPE LINES

Transcontinental Plans for Texas-New York Line

Transcontinental Gas Pipe Line Co. plans to spend $80,493,000 for 1,380 miles of 26-in. and distributing lines in New York, New Jersey, Pennsylvania, Delaware, and Maryland. The 14 compressor stations for the project have been estimated to cost $28,240,000; dehydration plants, $765,000; and meter stations, $794,000. These items together with other costs are expected to total $130,000,000 for the proposed natural-gas line to extend from Hemphill, Tex.

The application to the Federal Power Commission for construction of the system was presented by Claude Williams, Transcontinental president, as the first step toward getting a permit to build the project in case the company is an unsuccessful bidder for the Big Inch lines. No action is to be taken by FPC until the federal Government has disposed of the government-owned lines.

Natural gas would be mainly used for enrichment and reforming in connection with production of manufactured gas, according to Transcontinental.

Pipe-Line Rates, Rules Digest to Be Published

WASHINGTON.—A digest containing a compilation of interstate pipeline rates and rules will be issued in two volumes sometime in January by the National Petroleum Association.

One volume will contain all the rates on crude oil filed with the Interstate Commerce Commission, while the second will contain rates on petroleum products. The second also will include rules governing pipeline transportation and a complete list of pipe-line stations.

S. E. HUEY
CONSULTING ENGINEER

PIPE LINE
LOCATION SURVEYS
&
RIGHT-OF-WAY MAPS

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Aims Outlined in Shell's Technological Program

IMPORTANT items in the technological program of Shell Pipe Line Corp. are studies and experimental work aimed to increase line throughput, to reduce interbatch contamination, to halt external corrosion, to perfect internal-corrosion inhibitors, to develop more accurate metering devices, and to improve applications of automatic and electrical controls.

Transportation of natural gas through the same line with crude oil is being studied by Shell engineers, according to a report in The Go-Devil, Shell Pipe Line publication. Viscosity of the oil would be reduced; it is believed that in some cases it may be practicable to transmit gas from oil fields. Refineries may be furnished with gas for fuel which otherwise would have been wasted.

Development of the better scrapers is an important objective. The monthly power bill for the 14 stations between McCamey and Cushing is approximately $50,000. Decreasing the interstation line-pressure drops on that section alone by only 2 per cent would save approximately $2,000 per month. Scrapers already have been modified for special purposes. One type that will pass through short-radius bends is being used with good results. Another type, which jets debris before it to prevent clogging, has proved effective. Credited with furnishing ideas for these scrapers is James A. Fraser, who was master mechanic in Colorado City before he retired last spring.

Maintenance expense of pumping equipment is high because of solid material carried in crude streams. Varying but destructive quantities of microscopic scale, grit, and other abrasive materials cannot be filtered out completely.

Elimination of foreign matter from crude streams would allow use of "positive displacement" meters, the most accurate type known, hence the effort to develop a filter that will remove these abrasives from the oil.

Methods of varying the volumetric capacity of constant-speed recipro-

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cating-type pumps will be given consideration under the program. There is no way to reduce volume at present except to bypass back to the suction manifold. This method is expensive because of the energy lost in the process. At 800 psi. line pressure, 1 hp. of energy is required to pump 3 bbl. per hour. Thus a solution to this problem will effect substantial savings in power costs.

Slated for attention is a mechanical fuel injector for the Cushing-Wood River line's diesel engines. By increasing efficiency and reducing maintenance costs on the 78 "air-injection" type engines, appreciable economies can be effected. Pressure surges at reciprocating stations are destructive to pipe, fittings, machinery, and instruments, thus the elimination of pressure surges is important. Much study is being devoted to surge "alleviators" or dampening devices.

Personnel in the technological program are working on the idea of perfecting better automatic cut-off valves for use between lease tank batteries and feeder lines. In hilly terrain, air pockets form in the lines. Besides aggravating line corrosion, such airlocks stop the flow of oil. Perfection of better automatic cutoff valves will improve means of gathering crude and will reduce operating costs.

Other Shell affiliates are also interested in finding better ways of doing things. Shell Development Co., Shell Oil's products-pipe-line department, and its Pacific Coast and East of the Rockies territories are cooperating with Shell Pipe Line in this program to improve the art of pipe lining. Coordinating all of these activities is D. F. Sears of Shell Pipe Line.

The program in Shell Pipe Line is generally supervised by Chief Engineer D. H. Lewis, but is directed by J. E. Green. Green, A. S. Feild, and A. H. Hall, technological engineers, handle the bulk of the work. Green and Hall are located in Cushing, as are E. M. Cook, instrument maintenance supervisor, and J. R. Luttrell, senior chemist, who works on some of the problems. Feild, handling principally storage tank problems, is headquartered in head office.

Crossings Being Laid for 30-In. California Gas Line

Pipe is being laid by H. C. Price Co. for canal crossings near Blythe, Calif., in connection with the 214 miles of 30-in. natural-gas line construction of Southern California Gas Co. and Southern Counties Gas Co. This line is to extend from a point near Los Angeles to Blythe on the Arizona-California boundary to connect with the line to be built to that point by El Paso Natural Gas Co. from West Texas.

It is expected that the contractor,

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ECONOMY: Save approximately one-half labor and gas costs.

PORTABILITY: Can easily be carried from one pipe section to another.

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The H & M
Pipe Beveling Machine Co.
611 Petroleum Building, Tulsa, Oklahoma

H. C. Price Co. will organize a mainline spread this month for the laying of the 30-in. line in California. Work now going on is supervised by W. B. Williams with headquarters at Blythe. The entire operations of the contractor on this project are directed by Charles S. Le Noir, general superintendent.

Laying of Pipe For Monterrey Line Delayed

Laying operations for Gas Industrial, S.A., Monterrey, Mexico, will be delayed until about February 15 because of late delivery of pipe.

The project consists of 135 miles of 14-in. pipe from Monterrey to Reynosa, at the U. S.-Mexican border on the Rio Grande River. Operations for the contractor, Contratistas del Norte, S.A., (an affiliate of O. C. Whitaker Co.), will be directed by Dean Tannehill, chief engineer.

Ditching has been contracted by a Mexican firm which has had ditchers working along the right-of-way for 45 days.

It is expected that the project will be completed within 100 days after the pipe-laying spread is in the field.

Sinclair Starts Work On 50-Mile, 18-In. Loop

For the laying of a 50-mile 18-in. loop for Sinclair Refining Co., pipeline department, the contractor, O. C. Whitaker Co., is putting a spread in the field this week on the Sinclair trunk line at a point in the vicinity of Iola, Kans.

Letting of Stanolind Looping Contracts

Stanolind Pipe Line Co. is receiving bids this week for the construction of loops between Drumright, Okla., and Freeman, Mo., totaling 178 miles of 20 in. The undertaking has been divided into four sections. Although pipe is due to arrive February 1, it is expected that there will not be sufficient on hand to justify starting work until February 15.

Texas Connection Planned

WICHITA FALLS, Tex. — Continental Pipe Line Co. has announced plans to build in Montague County, Tex., a new 4-in. pipe line and gathering system extending from Stewart Lewis pool northwest through Hildreth pool to a point 11 miles north of Stoneburg. There the line will tie into Magnolia Pipe Line Co.'s Texas-Oklahoma 8-in. main line transporting oil to Louisiana and Gulf Coast points.

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. . . with RC Pipe Line Pigs

- By-Pass and Jet-Rotation features*
- Revolves as it cleans
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For crude, products, natural gas and water lines. Sizes 6-inch to 20-inch. Other types in sizes 2-inch to 26-inch.

*Patent pending.

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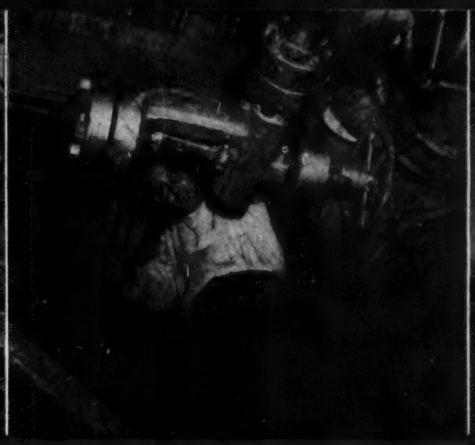
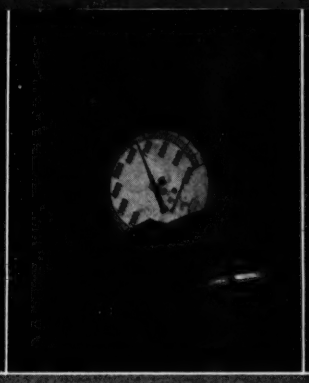
Brings another high pressure well safely into production

The well, located in the South Jennings Field (Jeff Davis Parish, Louisiana) cleaning itself of mud and water to open a new, deep gas-distillate sand for the field.





PICTURES on these pages high-light the major steps in completing another notably high pressure well, utilizing a Cameron 15,000 lb. test Christmas tree manifold. And again, Cameron field men, specially trained for pressure control work and the use of Cameron completion equipment, demonstrated the wisdom of maintaining such a field service organization to assist the operator in the completion of "problem" wells. This South Jennings well joins the long list of extremely high pressure wells finaled in recent months with the aid of Cameron equipment: Holland No. 1 in the Blue Lake Field, Brazoria County, Texas, with tubing pressure of 8200 lbs.; Elizabeth Regan No. 3 in the Egan Field, Acadia Parish, Louisiana, with tubing pressure of 8000 lbs.; Irby No. 1 in the Berclair Field, South Texas, with 6885 lbs.; and others.

This broad experience in pressure control, together with a complete line of well heads and Christmas trees ranging from 4000 to 15,000 lbs. test pressure, are available to operators everywhere. Contact your nearest Cameron representative (see below) for a recommendation and complete details on the Cameron equipment for your particular needs.

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Export: 74 Trinity Place, New York, N. Y. West Texas: Odessa (Telephone 1710). Oklahoma: 310 Thompson Bldg., Tulsa. California: 1442 Hayes Ave., Long Beach (7-2036). Wyoming: 356 N. Wolcott St., Casper. North Louisiana: Bossier City (P. O. Box 425).

STATISTICS and T

WEEKLY WELL COMPLETIONS . . . WEEK ENDED JANUARY 4, 1947

	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1947				
	Comp.	Oil	Gas	Dry	Footage	1947	1946	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	21	11	0	*10	29,969	21	30	0	0	0	0	0	0	0	0	0	0
Pennsylvania	48	24	1	†23	77,003	48	73	0	0	0	0	0	0	0	0	0	0
West Virginia	4	0	2	2	15,484	4	4	0	0	0	0	0	0	0	0	0	0
Ohio	24	11	5	8	57,648	24	14	0	0	1	0	1	0	0	1	0	1
Indiana	14	6	0	8	33,878	14	2	0	0	0	2	2	0	0	0	2	2
Kentucky	6	4	2	0	14,118	6	10	0	0	0	0	0	0	0	0	0	0
Illinois	45	22	0	23	113,296	45	30	2	0	0	7	9	2	0	0	7	9
Michigan	20	6	9	5	38,143	20	15	0	0	0	3	3	0	0	0	3	3
Kansas	59	34	6	19	192,251	59	53	0	0	0	4	4	0	0	0	4	4
Neb., Mo., Iowa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oklahoma	70	36	9	25	264,451	70	30	1	0	0	3	4	1	0	0	3	4
Texas	95	60	1	34	437,771	95	107	4	0	0	19	23	4	0	0	19	23
North Central	46	24	0	22	155,721	46	22	1	0	0	11	12	1	0	0	11	12
West	14	11	0	3	85,726	14	9	1	0	0	2	3	1	0	0	2	3
Panhandle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0
Gulf Coast	25	20	1	4	159,234	25	52	2	0	0	3	5	2	0	0	3	5
Southwest	10	5	0	5	37,090	10	13	0	0	0	3	3	0	0	0	3	3
Louisiana	9	8	0	1	85,366	9	7	1	0	0	0	1	1	0	0	0	1
Northern	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern	9	8	0	1	85,366	9	7	1	0	0	0	1	1	0	0	0	1
Arkansas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mississippi	5	3	1	1	50,413	5	6	0	0	0	0	0	0	0	0	0	0
Southeastern States	1	0	0	1	8,798	1	1	0	0	0	1	1	0	0	0	1	1
Montana	2	0	2	0	3,140	2	6	0	0	0	0	0	0	0	0	0	0
Wyoming	9	3	1	5	45,025	9	4	2	0	0	3	5	2	0	0	3	5
Colorado-Utah	8	7	0	1	47,661	8	2	0	0	0	1	1	0	0	0	1	1
New Mexico	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
California	40	30	1	9	115,441	40	36	0	0	0	9	9	0	0	0	9	9
Total United States	480	285	40	175	1,629,856	480	434	10	0	1	52	63	10	0	1	52	63
Total previous week	513	290	59	164	1,881,945	28,769	26,843	9	0	0	63	72	550	43	127	3,523	4,243
Total Jan. 5, 1946	434	246	44	144	1,518,197			2	0	3	36	41	2	0	3	36	41

Service wells included: *10, †22.

MARKET QUOTATIONS

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.17	....	....	....
19-19.9	1.21	....	....	....
20-20.9	1.24	$1.30	....	$1.17
21-21.9	1.28	1.32	....	1.19
22-22.9	1.32	1.34	....	1.21
23-23.9	1.35	1.36	....	1.23
24-24.9	1.39	1.38	$1.61	1.25
25-25.9	1.43	1.40	1.63	1.27
26-26.9	1.46	1.42	1.65	1.29
27-27.9	1.50	1.44	1.67	1.31
28-28.9	1.54	1.46	1.69	1.33
29-29.9	1.57	1.48	1.71	1.35
30-30.9	1.61	1.50	1.73	1.37
31-31.9	....	1.52	1.75	1.39
32-32.9	....	1.54	1.77	1.41
33-33.9	....	1.56	1.79	1.43
34-34.9	....	1.58	1.81	1.45
35-35.9	....	1.60	1.83	1.47
36-36.9	....	1.62	1.85	1.49
37-37.9	....	1.64	1.87	1.51
38-38.9	....	1.66	1.89	1.53
39-39.9	....	1.68	1.91	1.55
40 and above	....	1.70	1.93	1.57

*For crude from Daboval, El Campo, and Sandy Point. †Includes Lea County, New Mexico.

(Quotations shown here are f.o.b plant in tank cars and in cents per gal. as of last Monday.

REFINERY GASOLINE

Octane (A.S.T.M.)	78-80†	73-75
Mid-Continent*	7.375-7.625	6.750-7.000
Tex. Gulf Coast	7.50-7.75	6.750-7.125
New York Harbor	9-10.75	8-9.25
California		6.250-6.750

*Basic Oklahoma Group 3. †1939 C.F.R. (research method).

NATURAL GASOLINE

Grades—	26-70	18-55
Oklahoma (Group 3)	5.000	6.000
N. Texas (f.o.b. plant)	4.500	5.400
N. Louisiana (f.o.b. plant)	4.750	5.700
California (averages)	5.500	6.250

CRUDE-OIL PRICES

Representative posted schedules per bbl.

East Texas	$1.70
Kettleman Hills, California*	1.69
Beauregard Parish	1.65
Illinois Basin	1.82
Pecos County, Texas (Yates)	1.40
Bradford, Pennsylvania	3.55
Eastern Ill., and Western Ind.	1.67

Note: Crude prices exclusive of subsidy.

A.P.I. REFINERY REPORT

Week ended December 28, 1946
(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks—Gasoline	Stocks—Distillate	Stocks—Residual
East Coast	767	19,978	21,531	8,906
Appalachian	160	3,488	661	492
Ill., Ind., Ky.	793	16,974	6,257	4,159
Okla., Kan., Mo.	386	8,929	2,788	1,285
Inland Texas	232	3,693	522	742
Tex. Gulf Cst.	1,260	14,337	10,494	6,836
L. Gulf Cst.	351	4,843	3,608	2,096
N. La., Ark.	67	1,781	494	122
Rocky Mt.	141	2,129	478	649
California	811	16,964	12,108	28,090
Total 12-28-46	4,968	93,126	58,941	53,427
Total 12-21-46	4,820	89,554	60,608	54,217
Total 12-29-45	4,706	96,198	36,403	41,679

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended—	Bbl. of crude*
December 21, 1946	226,111,000
December 14, 1946	226,966,000
December 22, 1945	220,288,000

*Excludes unrefinable Calif. stocks.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	Jan. 4 crude oil	B. of M. Dec. demand	Dec. 28 crude oil
Alabama	1,150	1,200	1,100
Arkansas	79,000	76,000	80,250
California	883,500	845,000	889,000
Colorado	37,590	32,000	37,760
Eastern	59,000	64,200	63,000
Florida	255	200	250
Illinois	197,000	210,000	199,500
Indiana	18,900	19,000	17,400
Kansas	260,500	263,000	278,200
Kentucky	29,900	29,000	30,100
Louisiana	415,400	382,000	410,075
North Louisiana	102,400	.....	99,750
South Louisiana	313,000	.....	310,325
Michigan	42,225	46,000	41,820
Mississippi	84,495	60,000	84,750
Montana	21,910	24,000	21,980
Nebraska	700	800	700
New Mexico	102,700	98,000	102,500
Oklahoma	364,350	380,000	371,750
Texas	1,974,850	2,050,000	1,996,065
District 1 (Southwest)	18,950	.....	18,850
District 2 (Southwest)	134,050	.....	134,775
District 4 (Southwest)	207,825	.....	208,800
District 3 (Gulf Coast)	418,125	.....	422,625
District 5 (Eastern)	34,200	.....	34,615
District 6 (Eastern)	99,400	.....	99,375
East Texas field	309,600	.....	316,000
District 7C (West)	27,550	.....	27,700
District 8 (West)	491,250	.....	499,725
District 7B (W. Central)	34,300	.....	34,500
District 9 (N. Central)	118,100	.....	118,000
District 10 (Panhandle)	81,500	.....	81,100
Wyoming	102,230	96,000	103,130
Miscellaneous	.....	600	.....
Total United States	*4,675,655	4,677,000	4,729,330

Change from prev. wk., down 53,675

Total production January 1-January 4 ..... †18,803,660 bbl.

Same period last year (crude, plus condensate) ... 18,709,400 bbl.

*Not incl. 25,260 bbl. condensate. †Incl. 101,040 bbl. condensate.

GASOLINE STOCKS 93,126,000 bbl. as of December 28—up 3,572,000 bbl. One year ago 96,198,000 bbl.

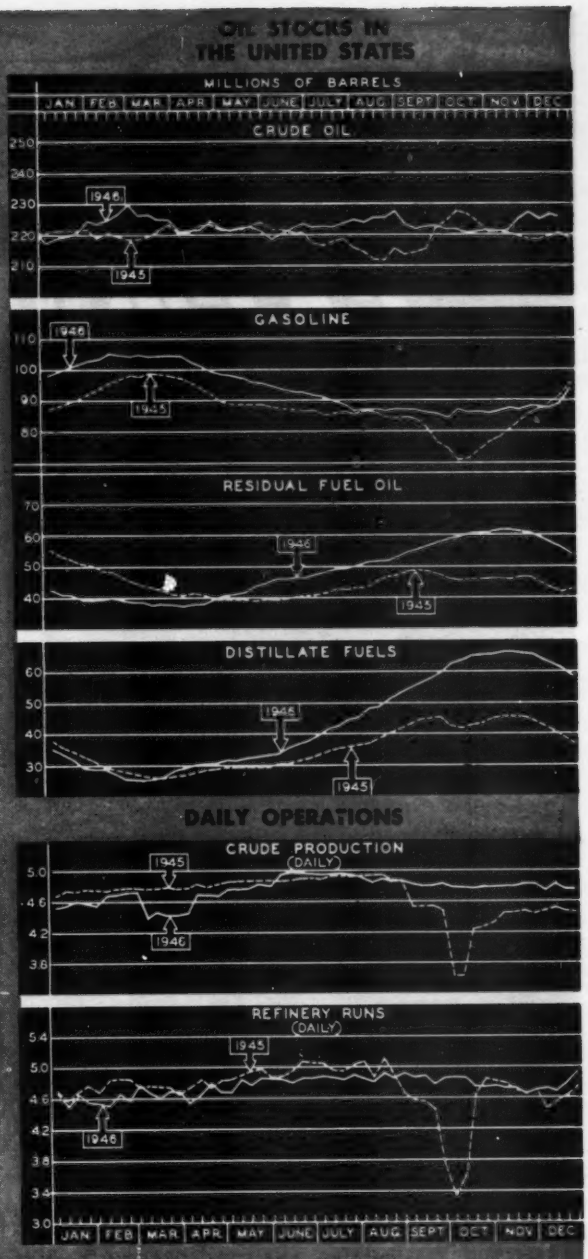
RESIDUAL FUEL-OIL STOCKS 53,427,000 bbl. as of December 28—down 790,000 bbl. One year ago 41,679,000 bbl.

GAS OIL AND DISTILLATE STOCKS 58,941,000 bbl. as of December 28—down 1,667,000 bbl. One year ago 36,403,000 bbl.

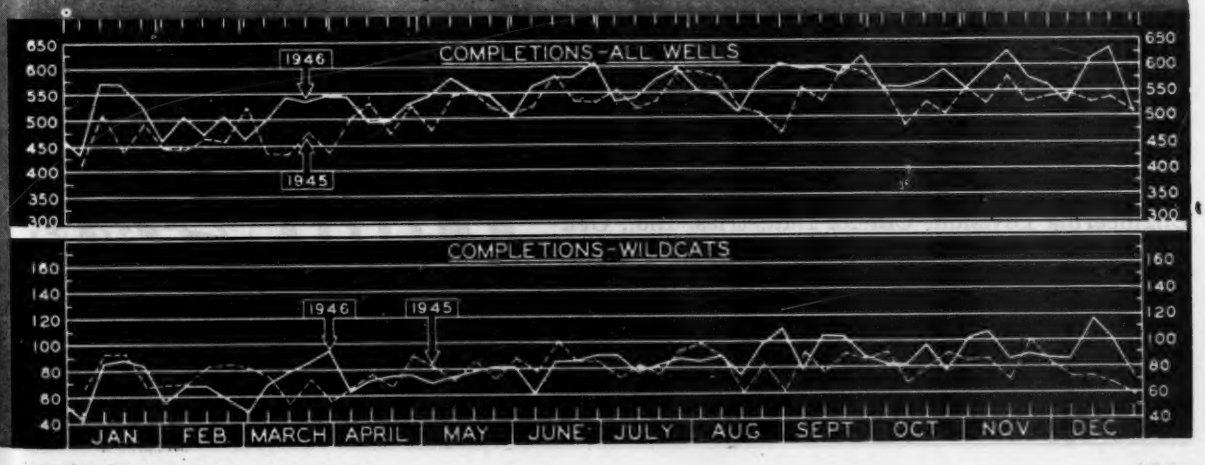
CRUDE-OIL PRODUCTION 4,675,655 bbl. as of January 4—down 53,675 bbl. One year ago 4,677,350 bbl.

REFINERY RUNS 4,968,000 bbl. daily week ended December 28—up 148,000 bbl. One year ago 4,706,000 bbl.

CRUDE-OIL STOCKS 226,111,000 bbl. as of December 21—down 855,000 bbl. One year ago 220,288,000 bbl.



Solid line charts weekly completions, service wells in Eastern area included.



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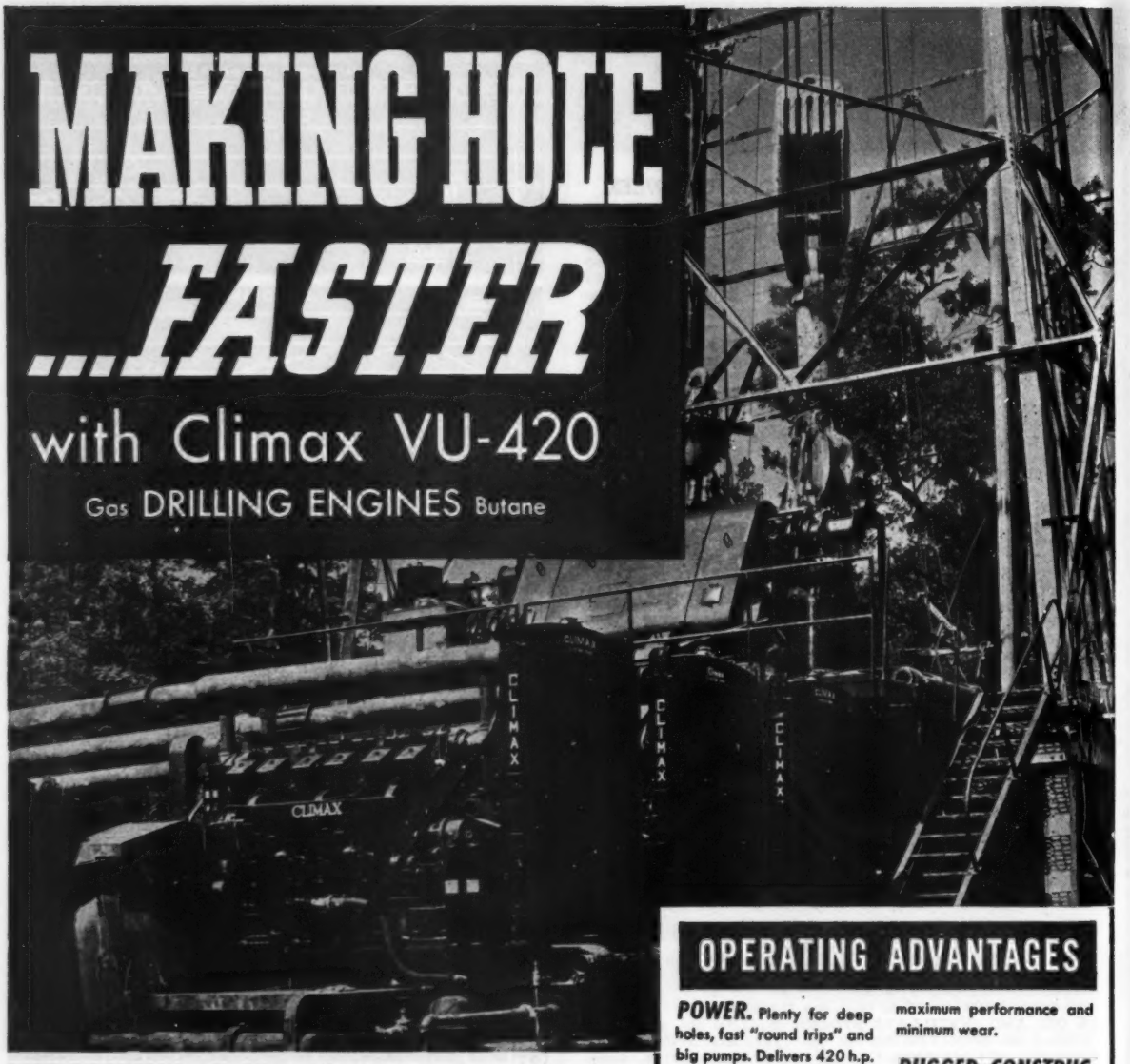

3 VU-420's compounded for 1260 h.p. Here's plenty of unfailing, flexible power for deep drilling.

OPERATING ADVANTAGES

POWER. Plenty for deep holes, fast "round trips" and big pumps. Delivers 420 h.p. at 1100 r.p.m. with radiator, fan and power take-off.

FAST GET-A-WAY. Quick, smooth acceleration *in seconds* to full power output.

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Exploration and Drilling

Year-End Discoveries Look Good

THE year ended on a fairly optimistic note for the exploration branch of the industry. In Wyoming, California Co. 2 Holst, SW NE SE 13-17n-77w, on Quealey Dome in the Laramine Basin, found the Tensleep productive to give the field a new and deeper pay. There appears to be about 180 ft. of Tensleep above the water line; the oil is 22° and, as usual for Tensleep, black.

At Elk Basin, Park County, along the Montana border, the year end was marked by the official completion of the first Madison lime well, a new deep pay. The significant thing here is that the well was finally completed in the lower 333 ft. of Madison, good for 247 bbl. of 30° oil through a ⅜-in. choke, although 340 ft. of what appears to be the best pay is cased off above the section now producing. The well is being handled by the unit operator, and is on top of the structure. If porosity is extensive, there seems to be at least a 673-ft. section of Madison above the water line.

In Kansas, Plains Exploration Co. 1 Swander, SW SE SW 20-28s-9w, Kingman County, is estimated at 1,000 to 1,500 bbl. daily from the Viola lime at 4,407-11 ft., after plugging back from salt water in the Arbuckle. This test appears to line up on a northeast-southwest trend, with many gaps, that extends from the Medicine Lodge pool on the southwest in Barber County, through Whelan, Yoder, and Burrton.

In Oklahoma, the Texola Drilling Co. et al 1 Meadors, NE NE NW 31-9n-11e, Hughes County, on drill-stem test was estimated good for 100 bbl. per hour from the Cromwell sand at 3,090-3,110 ft. The interesting thing about this well is that it found oil east of what had generally been considered the dividing line, east of which only gas would be found.

For West Texas, the T-X-L field in Ector County, already a major field, is in the spotlight with what is either a 2½-mile south extension, or a nearby new field which will produce from Devonian, Silurian, and Ellenburger. Rowan Drilling Co. 2 Parker, 2½ miles south of the nearest Ellenburger well, flowed at the rate of 80 bbl. per hour from Ellenburger at 9,625-73 ft., which puts it structurally higher than the nearest Ellenburger producers to the north. The well had previously shown for production in both Devonian and Silurian.

Down along the Gulf Coast, in South Texas, The Texas Co. 6 Yturria Land & Livestock Co. Carricitos Grant, in the Raymondville area of Willacy County, drilling below 14,671 ft., and headed for a test of the Frio section, is already the deepest well ever drilled in South Texas.

Off the Louisiana coast, Magnolia Petroleum Co. 58 Louisiana Gulf Block, 5 miles out in open water, off Point Au Fer, is drilling below 12,-200 ft.

TEXAS GULF COAST

Ohio Opens New and Deeper Horizon for Nada

HOUSTON.—A new and deeper producing horizon for the Nada pool of Colorado County has been opened by Ohio Oil Co. 1-A Nada Unit, Indianola Railroad Co. Survey, Section 24. Drilled to a total depth of 10,332 ft., with 7-in. casing set at 9.863 ft. and 5-in. liner cemented to bottom, operators perforated from 9,910-16 ft. for production test. The well flowed gas and condensate along with some water and has been shut in for storage tanks and flow lines. Shut-in pressure of 4,500 lb. was reported.

In the Cleveland area of Liberty County, Claud B. Hamill 1 J. C. Stuart, wildcat discovery in Thos. Devers Survey, on initial test flowed between 175 to 200 bbl. of oil daily through a ⅛-in. choke with 860 lb. flowing pressure on the tubing. Oil is 39°-gravity and is from saturation at 5,768-78 ft. Total depth is 5,782 ft., and 5½-in. casing is cemented to the bottom with perforations from 5,770-75 ft. The well is shut in awaiting storage space.

John W. Mecom 6-A E. Ker Cade et al, deepest producer from a new sand for the High Island dome of Galveston County, located in W. M. Hudson Survey, flowed 371 bbl. daily through a 3/16-in. choke, flowing pressure 1,025 on tubing and 1,150 lb. on the casing. Gravity 34° corrected, gas-oil ratio 570. Total depth is 7,359 ft. with 7-in. casing cemented to 7,260 ft. Production is through perforations at 7,141-59 ft. Operator has asked for a discovery allowable of 125 bbl. daily for this well.

Standard Oil Co. of Kansas 1 August Pietsch, wildcat test 8 miles north of La-Grange in Fayette County, in J. R. Phillips League, built up 1,450 lb. flowing pressure in 1 hour on a drill-stem test using ¼-in. chokes, top and bottom, through perforations in the Wilcox at 6,536-42 ft. Top choke was closed for 15 minutes and pressure built up to 1,950 lb., flowing gas and salt water with a slight spray of oil. Bottom-hole flowing pressure was 2,900 lb. and 3,100 lb. when shut in. Tool was pulled and recovered 20 ft. oil, 350 ft. salt water. Perforations were squeezed with cement in three stages. A drill-stem operation for a dry test, using ¼-in. chokes top and bottom for 1 hour and 15 minutes, recovered 1,170 ft. of water cushion, 5,064 ft. of salt water, and 180 ft. of mud. Operators are still attempting to get a dry test from the initial perforations.

Twelve new locations were reported for this district, two being wildcats, one each in Fort Bend and Orange counties. The six completions were all producers in proven fields, one being a new deeper sand in High Island in Galveston County.

UPPER GULF COAST TEXAS SUCCESSFUL WILDCAT

Galveston County: New oil pay in High Island field—J. W. Mecom 6-A E. Ker Cade et al, in W. M. Hudson Sur., TD 7,359 ft., top sand 7,141 ft., perf. 7,141-59 ft., IP 371 bbl. per day through a 3/16-in. choke, gas-oil ratio 570 to 1, TP 1,025 lb., CP 1,150 lb., gravity 34°, no water.

SOUTHWEST TEXAS

New Oil Pool Discovered In Tide Haven Area

CORPUS CHRISTI.—A new oil field has been opened in the new Tide Haven area by Ralph Johnston et al 1 F. Surkamp, loacated 9,700 ft. south and west of Magnolia Petroleum Co.'s discovery on the Live Oak Farms, and in Josiah Tilley League. This well is waiting on tanks and flow lines to be constructed before making a potential flow gage. On a test, through perforations at 8,533-35 ft. it flowed approximately 4½ bbl. of 43°-gravity oil hourly through a 6/64-in. choke with a gas ratio of 5,000 estimated.

A 1-mile west extension to the Jourdanton field oil production in central Atascosa County was evident in the drill-stem test run in Humble Oil & Refining Co. 1 S. P. J. S. A. Lodge, outpost test, which recovered 6,870 ft. of oil and gas from 7,370-90 ft. in the Edwards lime. On a drill-stem test at 7,145-65 ft. recovered 3 gal. of condensate with a good gas blow, 185 lb. working pressure.

The best well to be completed in the Pita field in Brooks County is the Humble 6-B Sullivan, which gaged 241 bbl. of pipe-line oil per day through a ⅛-in. choke through perforations at 7,771-80 ft. Operators are now waiting on potential gage. This well is east of the other wells in this field and is in the San Antonio de Encinal Grant.

Continental Oil Co. 1 Fred Ruschaupt, wildcat 4½ miles southwest of Meyersville, in DeWitt County, is coring ahead at 8,565 ft. in sand with oil odor. A drill-stem test at 8,541-49 ft. in the Wilcox recovered 4,000-ft. water cushion and 180 ft. of gas-cut mud, in 15 minutes, bottom-hole pressure flowing 1,400 lb., shut-in 3,600 lb. Another drill-stem test at 8,549-57 ft. recovered the 4,000-ft. water cushion and 30 ft. of gas-cut mud, with bottom-hole pressure 1,700 lb., open 20 minutes.

This test is in Patrick Dowlearn Survey, Abstract 152.

The name "Paso Real" has been given the field discovered by Magnolia 2 F. Armendaiz, in the San Juan de Carritos Grant, in Big Share 4, Willacy County, by the oil-field nomenclature committee of the South Texas Geological Society.

The 35 new locations included 8 wildcats, 2 in Starr and 1 each in Goliad, Karnes, Medina, Nueces, Williamson, and Zapata counties. One new oil pool in Nueces County was reported and six dry wildcats, two each in Nueces and Webb and one each in Edwards and Refugio counties.

SOUTHWEST TEXAS SUCCESSFUL WILDCAT

Nueces County: New oil pool, Rand Morgan 1-A fee, Richard King area, Sec. 5, Richard King farm lots, 1 mi. NE of Richard King field, top pay 5,604 ft., TD 5,848 ft., perf. 5,605-09 ft., IP 41 bbl. oil per day through a 3/32-in. choke, gas-oil ratio 5,965, TD 1,640 lb., CP 2,050 lb., no water.

SOUTHWEST TEXAS WILDCAT FAILURES

Edwards County: Shell Oil Co., Inc. 1 J. H. Brown, in LI&AA Sur. 9, 5 mi. NE of Rock Springs, dry, TD 5,718 ft.

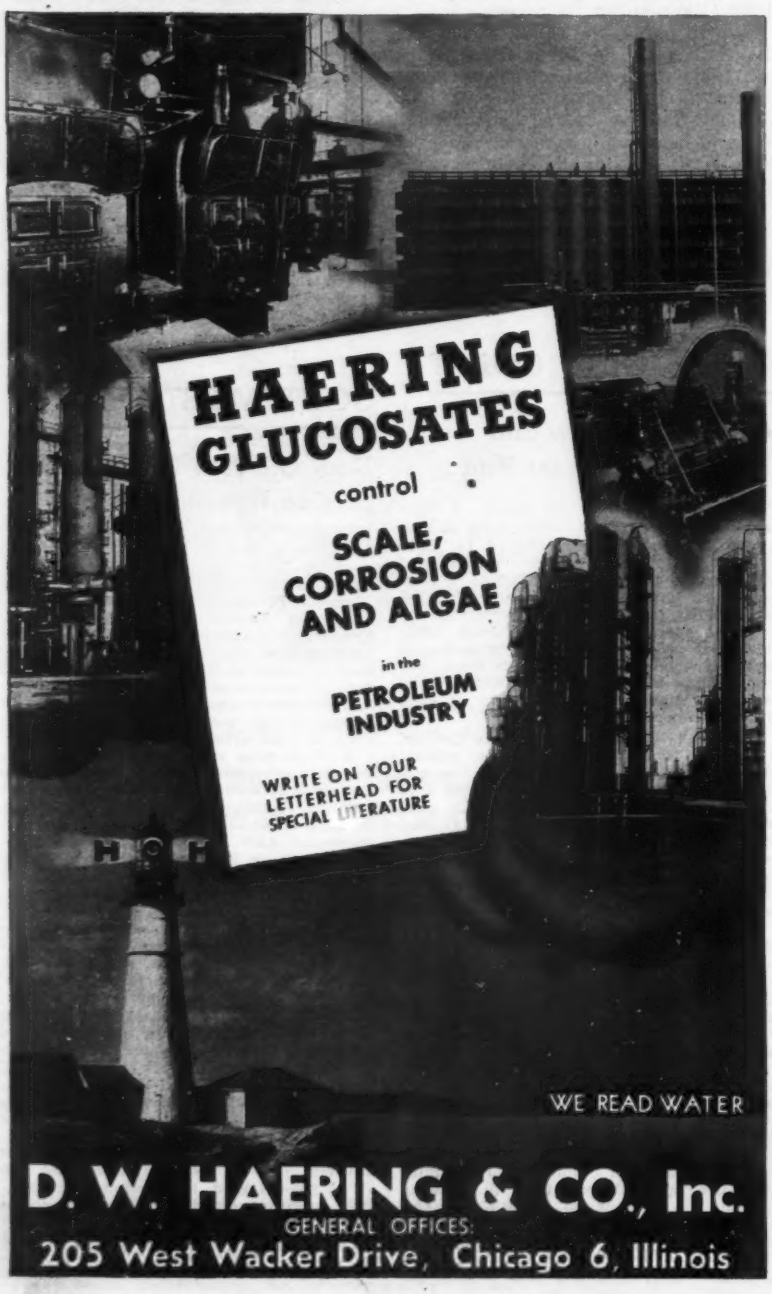
Nueces County: H. M. McCullough 1 Maggie Kelly, in A. F. Martin Sur. 150, ½ mi. S of Baldwin field, dry, TD 4,006 ft.

Wil-Tex Oil Corp. 1 C. H. Cook, in Sec. 18, Laureles farm tracts, 1½ mi. SE of Shield field, dry, TD 8,260 ft.

Refugio County: P. R. Rutherford et al 2-F Fred W. Fagan, in Mary Byrne Sur., 1½ mi. SE of Fagan field, dry, TD 5,948 ft.

Webb County: Killam & Hurd 1 D. G. Garcia, Sur. 786, Blk. 8, ½ mi. NE of Oilton, dry, TD 2,019 ft.

The Texas Co. 1 O. G. Kirkpatrick, CCSD&RGNG Sur. 25, 23 mi. SW of Freer, dry, TD 1,608 ft.



PERMIAN BASIN

Silurian Zone at Dollar Hide Gets First Producer

MIDLAND.—First production from the Silurian zone at the Dollar Hide field in southwestern Andrews County was reported last week at Magnolia Petroleum Co. 2 E. P. Cowden. All other completions have been in the Devonian. The 2 Cowden, on the north side of the field, in SW SE Section 4, Public School Lands, topped the Silurian at 8,265 ft. and on a drill-stem test at 8,229-8,345 ft., open 90 minutes, recovered 710 ft. of clean oil. Bottom-hole flowing pressure, through 5/8-in. choke, was 1,050 lb. and shut-in pressure was 3,500 lb. When drill pipe was broken down, following the test, an additional 1,710 ft. of oil was recovered. Operators were waiting on cement after setting 7-in. casing on bottom at 8,345 ft. The The discovery is ½ mile west of Magnolia's 1-B Cowden, which found sulfur water in the Silurian, topped at 8,450 ft., and abandoned at total depth of 8,769 ft.

A new producing area in Hale County, 6 miles northwest of the town of Petersburg, was in prospect last week when Stanolind Oil & Gas Co. 1 E. L. Fisher had a showing of oil at 6,894 ft. in limestone of Pennsylvanian age. The first core, to 6,910 ft., recovered 2½ ft. of fossiliferous lime with some porosity and some bleeding oil. The next recovery was 3½ ft. of slightly oil-stained lime with a showing of gas and bubbling fresh oil on fractures. Operators then ran a drill-stem test at 6,885-6,920 ft., through 5/8-in. bottom-hole choke, which made a steady blow of air throughout the test and recovered 60 ft. of drilling mud, 90 ft. of gas-cut mud, and 170 ft. of heavily oil and gas-cut mud. Additional cores at 6,920-32 ft. yielded 4 ft. of porous, fossiliferous lime, and a test made at 6,887-6,932 ft. brought gas to the surface in 59 minutes, with no estimate on the amount of flow. Recovery was 90 ft. of oil and gas-cut mud and 720 ft. of mud and oil, estimated to be about half oil. Top of the Pennsylvanian was thought to be around 6,000 ft., on an elevation of 3,316 ft. Operators were expected to run casing for a production test.

Rowan Drilling Co. 2 J. E. Parker, Ellenburger extension well 2½ miles south of the nearest producer from that formation in the TXL field in Ector County, had not made potential test on last report but had made a natural flow of 100 bbl. of oil an hour. The well kicked off after the hole was washed with water, displacing the water with oil when plugs were drilled from casing cemented at 9,650 ft., 69 ft. off bottom.

In west central Andrews County, some 12 miles west of the town of Andrews, Skelly Oil Co. and Olson Drilling Co. 1-A Lockhart & Brown, Section 21, Block A-41, Public School Lands Survey, made a drill-stem test in the top of the Devonian at 9,578-9,620 ft. Recovery was 1,470 ft. of water cushion, plus 300 ft. of drilling mud cut with some oil and gas. Previously, a test at 9,511-80 ft., open 1½ hours, made a good blow of air and recovered 350 ft. of water cushion and 290 ft. of oil and gas-cut drilling mud. Operators were to drill ahead. Top of the Devonian was said to be around 9,505 ft., on an elevation of 3,260 ft.

WEST TEXAS SUCCESSFUL WILDCAT

Ector County: Stanolind Oil & Gas Co. 1 Kayser, Sec. 34, Blk. 43, T2s, T&P Sur., 1½ mi. W of South Cowden field, elev. 3,983 ft., top Cisco pay in Pennsylvanian

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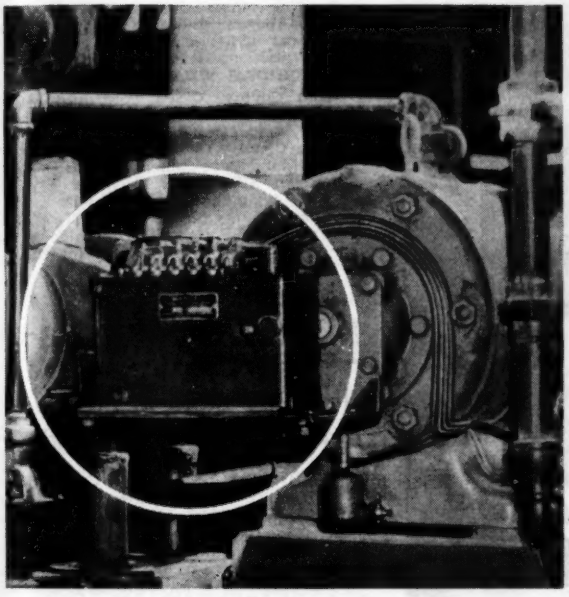

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WEST TEXAS WILDCAT FAILURES

Cochran County: Stanolind Oil & Gas Co. 1-C Wright, Brewster Co. School Land, 9 mi. W of Whiteface, elev. 3,771 ft., dry, TD 7,003 ft., no tops reported.

Garza County: Ralph Lowe 1 Ruth S. Blake, Sec. 1,200, I&GN Sur., 6 mi. NW of Post, dry, TD 4,214 ft., Yates 1,430 ft., San Andres 2,530 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—A San Andres exploration test was apparently in the making for southeastern Chaves County. Reports indicated Harry J. Steinburger & Son, Roswell, and Sam Sanders, Artesia, .N. M., may drill a 4,000-ft. wildcat on a 160-acre farmout from Kerr-McKee Oil Industries, Inc. The test will be the 1 Federal-Bush Reid, in SW NW 8-13s-30e. Location is some 35 miles east and south of Roswell and 10 miles west and south of the Caprock field.

Lea County developments during the week included Skelly Oil Co. 2 Steeler, 17-23s-37e, which recovered 4,000 ft. of salt water slightly cut with gas and distillate on a drill-stem test at 10,530-89 ft. in the Ellenburger. Operators were to run electric log. Sun Oil Co. 1-B McKinley, 20-18s-38e, cleaned out to 5,658 ft., then swabbed 34½ bbl. of fluid in 24 hours, cutting 4 per cent sediment, 20 per cent water and the remainder oil; and continued swabbing. Devonian Oil Co. 1 Federal, 19-9s-38e, on an estimated elevation of 3,969 ft., topped San Andres lime at 4,230 ft. On last report it was below 4,655 ft. in lime.

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Fig. F482 Fig. F497

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MICHIGAN

Development Continues In Winterfield Gas Field

SAGINAW.—Drilling up of Clare County's Winterfield Township gas field by Consumers Power Co. continued rapidly in the past week, accounting for 7 of the 20 Michigan oil and gas completions. Two other gas producers, six small oil wells and five dry holes completed the list. Three of the dry holes were wildcats. Five of 16 new locations are in Allegan County, 2 in Arenac, 2 in Ottawa, 1 each in Clare, Ogemaw, Kent, Oceana, Muskegon, Mecosta and Van Buren.

The oil well potentials ranged from 8 bbl. a day in a Genesee County well to 42 and 55 bbl. from 2 completions in Isabella. The others were in Tuscola, Muskegon, Allegan. Initial from the 9 gas wells was 42,700,000 cu. ft.

MICHIGAN WILDCAT FAILURES

Allegan County, Casco Township: Wilma Lyons 1 Joe Peich, SW SW SW 23-1n-16w, dry, TD 1,475 ft.

Isabella County, Deerfield Township: J. V. Wicklund Development Co. 1 Blanche E. Brown, SE SW NW 19-14n-5w, dry, TD 3,800 ft., plugged back to 1,622 ft.

St. Clair County, Fort Gratiot Township: Frank W. Potts 1 I. C. Ogden et al, NW NW NE 9-7n-17e, dry in Dundee, TD 738 ft., plugged back to 683 ft.

N. CENTRAL TEXAS

New Pay Zone in Prospect For East Henrietta Field

WICHITA FALLS.—In Clay County, Jack Grace 2 Bryant Edwards "B" had promises of a new pay zone in the new East Henrietta field after apparently missing the conglomerate pay section. It topped Caddo at 5,895 ft., recovered a show of oil in lime at 6,140-53 ft., and had the Ellenburger at 6,370 ft. Casing was set at 6,410 fe. before making production tests. Continental Oil Co.'s new Ellenburger discovery, 4 miles southwest of Vashti, the 1 Roscoe Scott, Section 3,239, TE&L Survey, installed pump and recovered 61 bbl. of oil load in 11 hours but was shut down by freezing weather.

In Foard County, 6 miles southwest of Crowell, Stanolind Oil & Gas Co. 1 John G. Haisell took a drill-stem test at 5,897-5,912 ft., in the Ellenburger topped at 5,897 ft., and recovered 5,100 ft. of salt water in 30 minutes. Bottom-hole pressure rose to 2,625 lb. in 15 minutes. Electric log was to be run before making tests higher up. A previous drill-stem test at 4,821-46 ft., open 1 hour, showed air immediately, blew some gas and recovered 80 ft. of heavily oil and gas-cut mud. This test was in the Strawn limestone, which had oil shows at 4,822-38 ft., and 4,860-68 ft. On last report operators were waiting on cement after setting casing at 4,921 ft.

Six miles southeast of Montague, in Montague County, Continental Oil Co. 1 S. T. Tompkins, ran a drill-stem test at 6,485-92 ft. and recovered 120 ft. of salty mud, but no shows of oil or gas. Bottom-hole pressure was 2,700 lb. Operators then drilled ahead. Top of conglomerate was 6,481 ft., with soft porosity from 6,481-92 ft.

NORTH CENTRAL TEXAS SUCCESSFUL WILDCAT

Clay County: R. C. Lipscomb 1 K. N. and L. P. Hapgood "A," Blk. 78, Marion County School Land Sur., 8 mi. N of Bellevue, elev. 945 ft., pay sand 4,985-5,000

ft. TD, IP pumped 224 bbl. oil first 24 hr., 127 bbl. oil second 24 hr.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County: Jack Grace et al 1 A. B. Edwards, Lot 22 Lulu P. Hunt Subd., George Bruner Sur., 3 mi. NW of Scotland, elev. 975 ft., dry, TD 5,567 ft., no tops reported.

W. T. Graham 1 R. Campbell, BBB&C Sur., 3½ mi. S of Anarene, elev. 1,163 ft., dry, TD 5,279 ft., lime with saturation 4,644-53 ft., sand with odor 5,089-91 ft.

Baylor County: W. F. Palmer 1 C. H. Taylor, J. H. Barclay Sur., 5 mi. SE of Seymour, dry, TD 1,330 ft. in chalky lime.

Clay County: L. T. Burns 1 Nellie Bates Green, A. Dickerson Sur., ¾ mi. W of Henrietta, elev. 858 ft., dry, TD 6,437 ft., Caddo 5,870 ft.

Cooke County: McElreath & Suggett et al 1 S. W. Brown heirs, R. F. Millard Sur., 2 mi. W of Callisburg, elev. 833 ft., dry, TD 5,835 ft. in Ellenburger.

Jack County: Charles Grace Drilling Co. 1 O. Sheppard, Sec. 56, Blk. 2, Henderson School Land Sur., 5 mi. E of Joplin, elev. 989 ft., dry, TD 4,620 ft., conglomerate with show of oil 4,390-4,402 ft.

F. Kirk Johnson 1 P. H. Riley, R. R. Stewart Sur., 2½ mi. W of Joplin, elev. 1,083 ft., dry, TD 5,014 ft. in shale, Caddo 4,412 ft.

Wichita County: Consolidated Oil Co. 1 V. B. Pyle, Blk. 6, Denton Co. School Land Sur., dry, TD 1,364 ft. in shale.

Wise County: Taylor & Nail 1 H. W. Coffman, A. C. Coffman Sur., 1 mi. S of Cottondale, dry, TD 1,060 ft. in shale.

WEST CENTRAL TEXAS WILDCAT FAILURES

Taylor County: Tal-Vez Oil Co. 1 George G. Collins, Alexander Thompson Sur., 5 mi. N of Abilene, elev. 1,670 ft., dry, TD 2,020 ft. in lime.

Shackelford County:: Stanolind Oil & Gas Co. 1 G. R. Davis, Sec. 48, Blk. 14, T&P Sur., 16 mi. NE of Abilene, elev. 1,758 ft., dry, TD 5,202 ft., Saddle Creek 1,550 ft., Palo Pinto 3,100 ft., Caddo 4,417 ft., Chapel 4,757 ft., Ellenburger 4,845 ft.

APPALACHIAN FIELD

Wirt County Wildcat to Test Corniferous Lime

PITTSBURGH.—In Reedy district, Wirt County, West Virginia, United Carbon Co. topped the Corniferous lime at 5,424 ft. in the Oriskany wildcat on A. Carter Smith farm from a surface elevation of 830 ft. Casing is being set at 5,435 ft. before testing the sand.

In Freemans Creek district, Lewis County, Hope Natural Gas Co. completed 9,083 Martin Lyden as a Gantz sand gas well gaging 5,116,000 cu. ft., total depth 2,161 ft.

In Mountain Cove district, Fayette County, Godfrey L. Cabot, Inc. plugged the wildcat deep test on Susan Kincaid farm at 5,934 ft. after several bad fishing jobs in the lower shales. The Corniferous lime had not been logged. The final formation was black shale, presumably the Marcellus. The surface elevation was 1,694 ft.

In Elk district, Kanawha County, United Fuel Gas Co. abandoned 5,784 John A. Boggs as dry after drilling through the Oriskany sand. Elevation was 921 ft., with the Corniferous lime at 5,093 ft., Oriskany 5,213-89 ft., and total depth 5,289 ft.

New locations totaled nine and were in Boone, Brooke, Doddridge, Gilmer, and Kanawha counties.

In southwest Pennsylvania, new locations totaled 14, and were located in Armstrong, Fayette, Greene, Indiana, Jefferson, and Washington counties.

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SOUTH LOUISIANA

Humble Still Trying for Kaplan-Discovery Completion

NEW ORLEANS.—Humble Oil & Refining Co. is still trying for completion of Kaplan discovery in Vermilion Parish. The test, 1 Alfred Ray Romaine et al, 25-12s-1e, on initial test gaged 102 bbl. of oil daily and a like amount of salt water, through perforations at 11,065-071 ft. The perforations were squeezed and 60 perforations made at 11,060-66 ft. where it flowed by heads and died. These perforations were squeezed and pipe reperforated from 11,060-68 ft. where operators continue to swab.

A new sand for the Sorrento Dome in Ascension Parish has been opened by Pan American Production Co. 21 United Lands Co., Inc. On a potential test well flowed 50 bbl. of 37°-gravity oil in 24 hours through a 15/64-in. choke with 120 lb. pressure and a gas ratio of 250. Total depth is 3,619 ft. in salt. Production is through perforations at 3,388-3,400 ft.

The California Co. 1 Louisiana Citrus Lands, Inc., second test for the Alliance area of Plaquemines Parish, has been gaged and shut in after being perforated from 9,366-70 ft. with .24 shots. The well flowed 132 bbl. of condensate per day and 4,625,000 cu. ft. of gas per day through a ¼-in. choke, tubing pressure 3,400 lb., 57°-gravity condensate. Total depth is 9,800 ft.

Eight of the completions reported this week are oil producers, one test being dry. One new sand was opened in St. Martinville field in St. Martin Parish.

SOUTH LOUISIANA SUCCESSFUL WILDCAT

St. Martin Parish: New pay in St. Martinville field—Continental Oil Co. 3-A Continental fee, 57-11s-6e, TD 8,056 ft., perf. 4,894-4,902 ft., IP 112 bbl. oil per day through a 7/64-in. choke, gas-oil ratio 707, 1,180 lb., gravity 30°, no water.

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EASTERN TEXAS

High-Pressure Gas Sealed Off in Freestone Co. Test

DALLAS.—The Texas Co.'s Smackover test in Freestone County successfully sealed off the high-pressure gas encountered in the Cotton Valley around 11,285 ft., and on last report was drilling ahead below 13,284 ft. in hard limestone. Cores from 13,205-24 ft. were unidentified but no shows of oil were reported. The test is the 1 White, located 4 miles northwest of Fairfield.

Late reports on wildcat activity included Humble Oil & Refining Co.'s deep test in Wood County. Its 1 McKnight was drilling below 10,494 ft. in sand, with streaks of shale. Standard Oil Co. of Texas 1 New Birmingham, Cherokee County, test, was at 10,015 ft. and preparing to perforate casing for a production test. Ten stands of drill pipe were said to have been dropped, delaying operations for a fishing job. It is understood the company plans to start at the bottom of the hole and test upward through porous sections found in the Travis Peak, Pettit and the Rodessa.

In Rusk County, 2 miles northwest of Motley, Tide Water-Seaboard Oil Co. 1 Bird, took its first core after picking up an anhydrite stringer drilling break at 6,235 ft. On an elevation of 367 ft., this scheduled Travis Peak test had base of the massive anhydrite and top of the Rodessa section at 6,105 ft. This was correlated low to Sinclair-Prairie Oil Co.'s Travis Peak failure to the east, which had the massive anhydrite base at 6,034 ft., on an elevation of 386 ft.

CANADIAN FIELDS

Record Well Completed In Turner Valley Field

CHATHAM.—Marking the largest completion in Turner Valley in more than a year, Home-Millarville 24, LSD 12, 33-20-3w5, finished with Madison lime at 7,891-8,375 ft., showed initial 24-hour flow of 1,143 bbl. after first acid. The well was given 1,000 gal. of acid in each zone, and packer has been run to determine source of production, after which further acid treatment will be given. Location is immediately northwest of Home-Millarville 2, LSD 6, completed in 1939 with Madison at 8,032-8,495 ft. and which has since produced over 1,400,000 bbl. Home-Millarville 2 had rated initial production of 2,435 bbl. The rise in the Madison northwest of the big producer indicates strong possibilities of an extension of the field in that direction, and additional drilling is likely.

Home-Millarville 26, LSD 15, 18-21-3w5, is testing west of the north extension of the field. Foothills Oil & Gas 25, LSD 6, 9-21-3w5, another west flank well, has contacted Madison lime at 8,627 ft.

Jumping Pound.—In the Jumping Pound field, in the foothills west of Calgary, Shell 5-7-1, LSD 5, 7-25-4w5, has started another deep test. Location is south and east of Shell 4-24-J discovery well, LSD 4, 24-25-5w5, which 2 years ago encountered a strong gas flow with a small light crude recovery after finishing in the Madison at 9,947 ft.

Kinsella.—In the Kinsella field, east-central Alberta, Imperial-Kinsella 26, LSD

10, 34-47-12w4, finished a commercial gasser. Imperial 19, LSD 10, 28-45-9w4, is drilling as a test of potential oil production in the eastern end of the field.

Pinhorn.—In the Pinhorn Dome area, near the Montana boundary, McColl-Union 6D-12-5-10, LSD 6, 12-5-10w4, got water in the Bow Island sand at 2,193 ft. and has been abandoned. A new test is starting in 25-4-10w4.

ROCKY MOUNTAIN

Oil Found in Northwestern New Mexico Gas Field

DENVER.—Northwestern New Mexico took the spotlight this week with a show for an oil discovery in the Dakota sand in the Kutz Canyon gas field in San Juan County in Paul B. English & Byrd-Frost, Inc., 1 Government, C NW SW 4-27n-10w. It had the top of the Dakota at 6,475 ft. Cores from 6,475-79 ft. showed hard and tight sand. Next core at 6,479-81 ft. recovered 2 ft. of bleeding core. Next 1½ ft. resulted in a recovery of core from which oil was dripping. At that depth, 6,482½ ft., coring was suspended to run 6⅝-in. to the top of the sand at 6,475 ft. Gravity of the oil was not reported, but samples showed it to be green oil typical of that formation. It was decided not to drill further into the sand until casing was run as prior to that time the only string in the hole was the 13⅜-in. at 400 ft. On the way down, the Point Lookout in the Mesa Verde group of Cretaceous age was topped at approximately 4,402 ft. Saturated sand was cored at 4,402-50 ft., and in a drill-stem test at 4,412-54 ft., open 15 minutes, there was a recovery of 50 ft. of 72°-gravity oil with a strong flow of gas. More sand was encountered at 4,423-43 ft., with a recovery of 50 ft. of oil and more gas in 15 minutes. No additional tests were made and drilling to the Dakota was resumed.

A discovery of oil at this location may prove to be of major importance. The structure is out in the San Juan basin, and the test is the first to the Dakota sand. To the west on the rim of the basin are located the Hogback, Rattlesnake and Table Mesa oil fields which produce high-gravity crude from the Dakota at 800 to 1,300 ft. The crude runs from 56° gravity at Table Mesa and 63° gravity at Hogback, to 76° gravity at Rattlesnake. These fields have been producing since 1924. At Hogback only 160 acres proved productive, but since discovery it has produced approximately 2,300,000 bbl. of oil from 7 wells. The theory long has been held that the oil is migratory, either from some more distant area or in deeper horizons. The latter was tested out with three wells to the Pennsylvanian at Rattlesnake. Production was found in two of these, but not in sufficient quantity to warrant the belief that a major pool could be developed. On the other hand, the theory of migration from some other source was strengthened by the fact that at Hogback, the nearest to Kutz Canyon, considerably more oil has been produced than the estimated reservoir capacity of the sand. Immediately to the north of Kutz Canyon, high-gravity oil in small quantities has been developed in shallow wells in horizons far above the Dakota.

Kutz Canyon has produced gas for a number of years in the Picture Cliff sand of upper Cretaceous age at around 2,000 ft., the wells making from 1,000,000 to 4,000,000 cu. ft. per day. There is little evidence of structure and it was believed the gas came from a stratigraphic trap. This gas area lies immediately to the north of the Dakota sand test, and Southern Union Production Co. is the principal operator. Late last year, the English-Byrd-Frost interests acquired half interest in the 12,000-

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acre block to the south from the Kutz Canyon Oil & Gas Co. The deal was made on the basis not only of surface geology, but by torsion balance, gravity meter and seismograph surveys. These interests then acquired several thousand acres surrounding the block. Half interest then was reported sold to Stanolind Oil & Gas Co. The latter, also, is reported to have acquired the oil rights in the Southern Union acreage of nearly 4,000 acres to the north. Further evidence of the importance of the strike lies in the fact that running from Kutz Canyon northwest into southwestern Colorado are a series of structures which produce gas from the Dakota, or higher horizons, at Fulcher Basin, Ute Pasture, and Barker Creek domes. Four wells to the Pennsylvanian at around 9,000 ft. on Barker Dome have come in for 30,000,000 to 60,000,000 cu. ft. per day. A fifth deep well is now drilling on the Colorado side in Montezuma County.

Oil show southwestern Colorado.—Hudson-Coryell 1 Schmidt, C NW NE 36-34n-12w, Red Mesa District, La Plata County, Colorado, immediately north of the New Mexico line and on the same general line of folding described above, has a show for a producer in the Niobrara lime of upper Cretaceous age, above the Dakota sandstone. It topped the lime at 3,050 ft., and saturation continued to present depth at 3,105 ft. Drilling stopped here to run the 7-in. which was set at 3,057 ft. The plan is to drill through the lime, acidize and test. The original objective was the Dakota. Location is 2 miles north and east of nine wildcats drilled within a distance of 7 miles a number of years ago, several of which showed oil in small but uncommercial quantities in the Dakota and some gas in upper horizons.

Quealy Dome discovery.—California Co. 2 Holst, NE SE 13-17n-77w, Quealy Dome, Albany County, Wyoming, deepened from 4,207 ft. in the Morrison to the Tensleep, a discovery in the latter at 5,654 ft., total depth, swabbed 127 bbl. of 21.5°-gravity oil in 8 hours, and is shut down to install pump. Top of the Tensleep was at 5,480 ft. Test was through perforations with 190 holes at 5,480-5,510 ft.

New operations.—Twelve new operations were reported, of which eight were in the Rangely field and one a wildcat in Huerfano County, in Colorado; one was in the Garland field in Wyoming; and one each in Bowdoin and Kevin-Sunburst in Montana. The wildcat is Mid-Alamo Oil Co. 1 Bartlett, NE SW NW 27-27s-68w, Badito-Alamo district, Huerfano County, ½ mile southeast of its 1 Pressey-Klein, abandoned at 2,559 ft.

Completions.—Nineteen wells were completed, of which 10 were oil wells with initial production of 1,308 bbl., 3 were gas wells and 6 were dry holes. Seven of the oil wells, with initial production of 1,007 bbl., were in the Rangely field in Colorado. Colorado also had one dry hole in a wildcat. Wyoming had 9 completions, of which 3 were oil wells for 301 bbl., 1 was a gas well and 5 were dry holes. These included 5 wildcats, 3 wells in the Byron field and 1 in Middle Baxter Basin. Montana had two gas wells completed, one each in Bowdoin and Kicking Horse fields.

COLORADO WILDCAT FAILURE

Badito - Alamo, Huerfano County: Mid-Alamo Oil Co. 1 Pressey-Klein, SE NE NE 28-27s-68w, TD 2,559 ft., dry, rig skidded ½ mile to southeast.

WYOMING SUCCESSFUL WILDCATS

Quealy, Albany County: California Co. 2 Holst, SW NE SE 13-17n-77w, TD 5,654 ft., top Tensleep 3,480 ft., 5½-in. 5,654 ft., perf. 190 holes 5,480-5,510 ft., swabbed 127 bbl. oil in 8 hours, gr. 21.5°, old well deepened from 4,207 ft., discovery in Tensleep.

South Spring Creek, Park County: Texas Co. 3 Unit, C NW NW 13-49n-102w, TD 4,579 ft., top Tensleep 3,893 ft., top Madison 4,435 ft., est. 24 bbl. per day on swbg. test, gr. 12.9°, discovery in deeper pay.

WYOMING WILDCAT FAILURES

South Garland, Big Horn County: Mackinnie Oil & Drilling Co. 1 Sheridan Milling Co., Lot 43-C-55n-97w, TD 4,684 ft., water in Dakota, top 4,620 ft., plugged.

East Bailey, Carbon County: Wasatch, Cameron & Phillips 1 Johnston, SW NW NW 24-26n-89w, TD 4,607 ft., water in Nuggett sand, top 4,530 ft., plugged.

Mill Creek, Carbon County: Texas Co. 1 Unit, NE NE SE 14-20n-81w, TD 6,389 ft., top Tensleep 5,677 ft., plugged.

MISSISSIPPI

Jones County Test Showing For Possible Discovery

JACKSON.—Reports received here indicated Superior Oil Co.'s Forrest County deep test, the 1 Bradford, 21-3n-13w, was to be a dry hole. Operators were said to be swabbing from perforations between 12,700-13,350 ft., and putting some oil into pits. Samples of oil taken from the burning pits has tested 37° gravity.

In Jones County, Gulf Oil Corp. 1 Major, 29-6n-11w, was showing for a possible discovery. Four drill-stem tests were run. At 7,306-18 ft., recovery was 280 ft. of oil-cut drilling mud, with bottom-hole flowing pressure of 1,135 lb. At 7,318-28 ft., it recovered 405 ft. of fluid, 70 per cent oil, with bottom-hole pressure of 350 lb. At 7,331-38 ft. recovery was 124 ft. of fluid, still testing 70 per cent oil, and bottom-hole pressure had increased to 450 lb. However, the last test, at 7,403-7,410 ft.,

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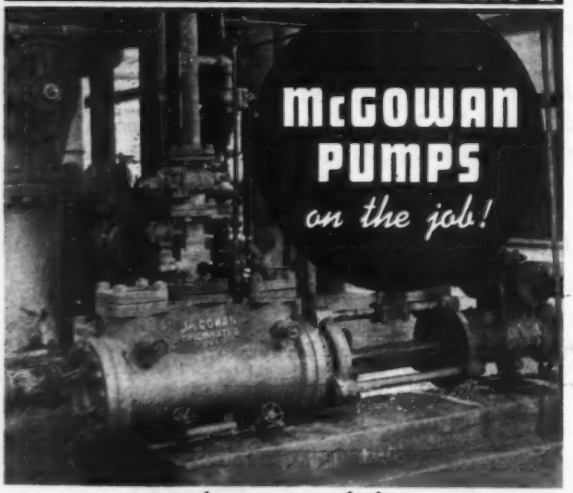

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only 35 ft. of fluid was recovered, cutting 90 per cent mud and 10 per cent heavy, black oil. On last report operators were coring below 7,430 ft.

In Hinds County, Kingwood Oil Co. 1 W. G. Plummer, a wildcat in NW SW SW 14-5n-1w, was to skid the rig for another try after drill pipe stuck at 3,300 ft. In Holmes County, Skelly Oil Co. 1 Spann, 22-14n-1w, was drilling below 6,900 ft., after recovering 1,200 ft. of salt water on a drill-stem test at 6,750 ft. Formation tested was not made known.

FLORIDA WILDCAT FAILURE

Osceola County: Humble Oil & Refining Co. 1 Hayman, C SW SE 12-31s-33e, dry, TD 8,798 ft. in igneous, no tops reported.

OKLAHOMA

Kingfisher County Wildcat Recovers Salt Water

ATLANTIC REFINING CO. 1 Vilhauer, SW NE NW 34-17n-6w, key wildcat 5 miles northwest of Loyal, has apparently condemned the Hunton lime as a producing horizon in its immediate area in Kingfisher County. The well encountered the Woodford shale at 8,615 ft. and the Hunton at 8,643 ft., with a 6-ft. core at 8,660-66 ft. showing only fine, tight dolomite with no oil or gas. After cutting the core, operator drilled ahead to 8,675 ft. and made a 1-hour drill-stem test of the interval at 8,641-75 ft. Recovery, however, was 364 ft. of drilling mud and 6,997 ft. of salt water with no oil and a very slight show of gas. The wildcat is being drilled ahead to the Wilcox zone .

A. G. Oliphant is apparently opening a new oil pool for Osage County with his 1 Osage, SW SW NE 1-25n-4e, in the western part of the county. The 1 Osage encountered the Mississippi chat at 3,304 ft., had gas at 3,307 ft. and found oil saturation from 3,328-45 ft. Operators have set 7-in. casing at 3,304 ft. in order to make a thorough test of the oil showings.

Carter Oil Co. et al will run swab at their prospective Garvin County discovery, the 1 Hart, SE SE SE 23-3n-3w, 2 miles west of the Southwest Antioch pool. This decision was made following failure of the wildcat to flow when tubing had been run to 7,206 ft. and the mud circulated out. On the last test through drill pipe, the well flowed 26 bbl. of 59.4°-gravity distillate in 4½ hours through perforations at 7,221-28 ft.

J. J. Fleet 1 Patten, SE SE NE 26-14n-4w, outpost test 1½ miles off the east flank of the West Edmond pool in Oklahoma County and about 1 mile west of the Edmond pool, has apparently extended Bartlesville sand production of the latter pool. Responding favorably to an 80-qt. shot in the pay zone at approximately 6,404-44 ft., the well is flowing an estimated 200 bbl. per day. The Bartlesville was topped at 6,404 ft., but the well was carried on to a total depth of 6,610 ft., topping the Hunton at 6,555 ft. and the Sylvan at 6,610 ft.

OKLAHOMA SUCCESSFUL WILDCAT

Cotton County: Joe Blalock 1 Varner, NW NW 10-3s-11w, pumped 47 bbl. of oil per day from sand at 1,609-35 ft., TD 1,635 ft.

OKLAHOMA WILDCAT FAILURES

Cotton County: Bridwell 1 Gunn, SW NW 32-3s-10w, dry, TD 1,702 ft., no tops reported.

Kingfisher County: Phillips 1 Forbis, C NW SE 21-16n-5w, dry, TD 7,205 ft., Oswego 6,396 ft., Hunton 7,164 ft.

Seminole County: Culham Petroleum et al 1 Whitney, SW SW SE 32-10n-8e, dry, TD 4,435 ft., Cromwell 3,603 ft., Hunton 4,207 ft., Wilcox 4,426 ft.

KANSAS

New Oil Pool Indicated For Ellis County

STANOLIND OIL & GAS CO. is apparently opening a new oil pool in Ellis County at the 1 Irvin, SE SE SE 6-14-19w, 2 miles west of the Pleasant pool. The 1 Irvin, first exploratory effort of Stanolind in the county for the new year, made 11 bbl. of fluid per hour while swabbing at 2,000 ft. from the surface during a 12-hour test. Water content of the fluid was approximately 22 per cent at the start of the test but had declined to less than 7 per cent at the conclusion. Productivity has been estimated at 400 bbl. per day by the operators, and preparations are under way to take potential tests.

From an elevation of 2,240 ft., the 1 Irvin topped the Lansing at 3,510 ft. and the Arbuckle at 3,852 ft. Casing was set at 3,853 ft. and the plug drilled to 3,860 ft. from which depth it bailed about ½ bbl. of oil per hour. Hole was then deepened to a total depth of 3,874 ft. and given an acid treatment of 1,000 gal. prior to the 12-hour swab test.

Bennett & Roberts drilling Co. 1 Dobrinski, NW NW NE 16-17s-9w, wildcat test 1 mile north of the town of Lorraine in Ellsworth County, has been shut down following a swab test of the Lansing lime

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at 2,978-81 ft. The test was of 3 hours' duration and recovery was at an average rate of 9 bbl. of fluid per hour during that time. The fluid ran about 50 per cent water but this was thought to be decreasing toward the end of the test. From an elevation of 1,796 ft., the Lansing was logged at 2,906 ft. with a good show of oil encountered from 2,986-3,026 ft. Conglomerate was topped at 3,230 ft. and the well was carried to a total depth of 3,300 ft. before being plugged back to set 5-in. casing at 3,166 ft.

Westgate-Greenland 1 Vanier, SE SW NW 8-14s-2w, Saline County wildcat, failed to produce last week on a final test of the Viola lime through perforations at 3,184-94 ft. A small show of oil and water was encountered at this depth, but a 2,000-gal. acid treatment only increased the water. The Viola was reached at 3,184 ft., Simpson at 3,319 ft., Arbuckle at 3,392 ft. and total depth was 3,400 ft. No shows were found in the lower formations, and 5-in. pipe was set to 3,241 ft. to test the Viola.

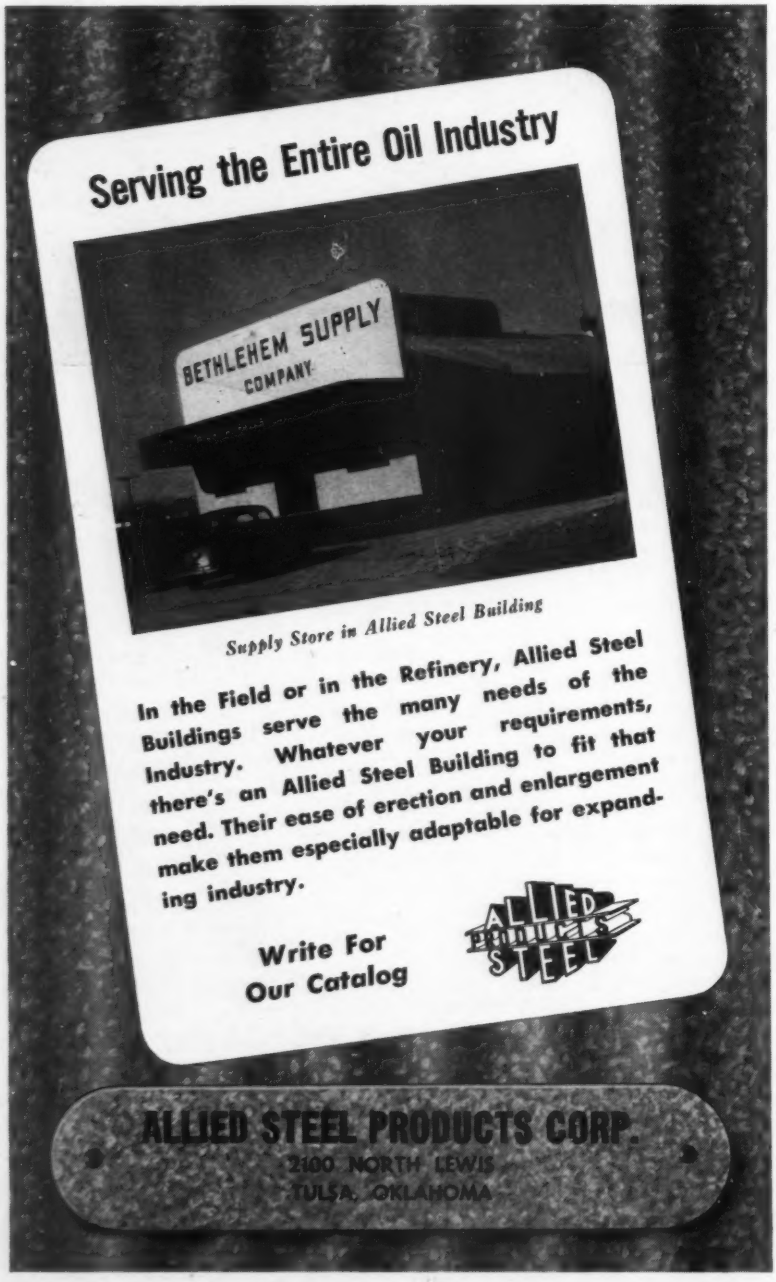
KANSAS WILDCAT FAILURES

Marion County: S & S Oil et al 1 Stallwitz, NW NE SE, dry, TD 2,582 ft., Kansas City 2,085 ft., Misener 2,512 ft. with show of oil.

Pratt County: Stanolind 1 Curtis, SE SE NW 10-26-15, dry, TD 4,605 ft., Arbuckle 4,532 ft.

Sumner County: Oree et al 1 Frantz, NW NW NE 35-30-2, dry, TD 4,335 ft., Kansas City 2,099 ft., Arbuckle 4,298 ft.

Trego County: Palmer Oil Co. 1 Dietrich, NW NW SE 36-11-21, dry, TD 4,000 ft., Kansas City 3,595 ft., Arbuckle 3,964 ft.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LA.-ARK.

Several Active Wildcats Drilling Ahead

SHREVEPORT.—While the holidays and cold weather halted drilling in nearby areas, North Louisiana reported a number of active wildcat tests drilling ahead. In Madison Parish, 12 miles south of the Delhi field, C. A. Kinard 1 Ayer Timber Co., NW SW SW 19-15n-10e, was drilling below 5,160 ft. in shale. Sample tops were: Wilcox 2,256 ft., Midway 3,860 ft., chalk 4,360 ft., and Tuscaloosa 4,925 ft. Two miles north of Packton, in Winn Parish, H. L. Hunt and Nebo Oil Co.'s 136-F. Goodpine Oil Co., NW SW 21-10n-2w, was drilling ahead below 5,809 ft. in the Tuscaloosa after recovering 1½ ft. of fairly porous sand having a gas odor and distillate taste, in a core at 5,789-5,809 ft. Four miles east of the Haynesville field, Claiborne Parish, Union Producing Co. 1 J. N. Wise was considered dry at 5,710 ft. after a drill-stem test at 4,126-42 ft. recovered 60 ft. of mud with a few gas bubbles. Tops reported were: anhydrous 3,925-4,123 ft., Travis Peak 5,284 ft.

ILLINOIS

New Oil Field in Prospect South of Concord Field

MATTOON.—A new oil pool for White County is apparently being opened 2 miles south of the Concord field by the W. O. Allen 1 Ackerman, NE NE SW 4-7s-10e. Good oil saturation was encountered in the Aux Vases sand at 2,897-2,912 ft., total depth, and a 1-hour drill-stem test got gas in 25 minutes, 2,360 ft. of clean oil and 300 ft. of oil-cut mud. Operators are now waiting on cement to set with 5½-in. casing cemented to 2,890 ft.

The Sam Malis et al 3 Schnitz, SW SE SE 6-1n-13w, in the Lancaster pool of Wabash County, was successfully completed last week as one of the largest producers in the state in several weeks. It was finaled in the Rosiclare at 2,797-2,805 ft., total depth, for an initial production of 1,400 bbl. per day flowing. It has not been acidized.

Also successfully completed during the past week was the National Associated Petroleum Co. 1 Oak Hickle, SE NW NE 33-3n-7e, which extends the East Flora pool of Clay County about ½ mile to the southeast. This well was completed on pump for an initial production of 200 bbl. daily from the McClosky lime at 3,042-47 ft. following an acid treatment of 1,000 gal.

Illinois completions totaled 45 for the past week, a high number considering the holiday season and resultant slowdown of operations. Of the total number of tests finaled 22 were oil wells and 23 were dry holes. Eight of the wells were wildcats, one of which was an extension and the remainder dry holes. New operations announced during the week totaled 29 exclusive of wildcats, which were not reported.

ILLINOIS SUCCESSFUL WILDCAT

Clay County: National Associated Petroleum Corp. 1 Oak Hickle, SE NW NE 33-3n-7e, pumped 200 bbl. daily, McClosky 3,042-47 ft., 1,000 gal. acid, TD 3,147 ft.

ILLINOIS WILDCAT FAILURES

Clinton County: Boyd W. Quick 1 Hemminghaus-Holman Comm., NW NW SE 10-2n-1w, dry at 1,467 ft., Benoist 1,459 ft.

Coles County: John E. Carlson 1 Mary

Jones, SE NW SW 32-12n-10e, dry at 1,200 ft., 5½-in. casing collapsed at 1,170 ft.

Effingham County: National Associated Petroleum Corp. 1 John Meyer, NW NW SE 34-9n-6e, dry at 2,517 ft., Glen Dean 1,948 ft., Barlow 2,068 ft., Ste. Genevieve 2,345 ft.

Fayette County: National Associated Petroleum Corp. 1 Sam Kistler, NE SW NW 17-6n-2e, dry at 2,140 ft.

Jasper County: Robinson-Puckett 1 Newkirk Cons., NW NE NW 18-7n-11e, dry at 2,897 ft.

Jefferson County: National Associated Petroleum Corp. 1 Irvin Ward, NE NE NE 23-2s-2e, dry at 2,832 ft.

Shelby County: National Associated Petroleum Corp. 1 E. P. Burgess, NE NE SW 4-9n-6e, dry at 2,322 ft.

CALIFORNIA

New Shallow Pay At Cymric Field

LOS ANGELES.—Honolulu Oil Corp. has made a discovery in the Phacoides formation in the northern part of the Cymric field of Kern County. On a formation test at 4,788-5,030 ft., the company's 255 Midway-Premier in 22-29s-21e, flowed 34° oil at a 1,000-bbl. rate. The well had been plugged back from the Oceanic formation which, though productive elsewhere in the field, was no good at this location.

To the east in Section 23, Universal Consolidated Oil Co. has completed 9 Sauerdough in the Point of Rocks formation flowing 106 bbl. of 45° oil through a ¼-in. choke. Operator is moving in equipment to drill 10 Sauerdough about 50 ft. north. The latter will be an Oceanic zone test. Deep sand development in the last year has made Cymric the most active field in the San Joaquin Valley and the second most active in the state. It was originally discovered in 1916.

Standard of California has completed an excellent well in the old Kern Front field about ½ mile from its discovery well which was brought in 32 years ago. The company's No. 11-9 in 27-28s-27e, is currently pumping 329 bbl. of 13.3° oil, 20 per cent cut. Depth is 2,500 ft. with 7-in. shut-off at 2,215 ft. The well is considered a good example of the effect on productivity of modern completion practice.

Indications are that Belridge Oil Co. will shortly prove the existence of a deep productive sand in the South Belridge field of Kern County, as preliminary tests are said to have looked good. Preparations are being made to complete 62-W-33 in 33-28s-21e, from an interval in Point of Rocks equivalent between 13,945 and bottom of the hole at 13,975 ft. Acreage in the area is rather widely held, although Belridge Oil Co. is the principal operator.

Standard's Kings County wildcat, 73-30V, on the Middle Dome of Kettleman Hills, which had good oil and gas showings on the ditch a week ago, is tied up with a fishing job. Drill pipe is stuck 11 ft. off bottom at 12,359 ft.

Chanslor-Canfield Midway Oil Co. has landed perforated liner on bottom at 8,062 ft. in its Monterey County wildcat, 6-G1, in 6-23s-10e, near the town of San Ardo. This is, however, believed to be just a routine test prior to abandonment. The current flurry of wildcatting in Monterey County has been unproductive to date. The Texas Co. has abandoned two test holes and is working on a third. Shell has recently spudded a wildcat just south of King City, but has run into an unusual lost circulation problem just above 500 ft.

Wildcatting activity in Orange County was continuing at an undiminished rate as the new year opened. Latest starts include Amerada's 62-7 Anaheim Sugar in the West Newport area, 7-6s-10w, and Almeria In-

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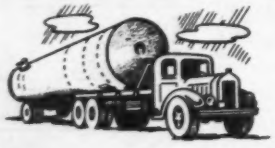

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dustries Co. 1 on the Irvine Ranch in 20-6s-8w.

New locations authorized in California last week totaled 35, up 14 from the previous week. Total new locations for 1946 was 1,812, a 15 per cent decrease from 1945. The 1946 total was, however, greater than that of any prewar year.

CALIFORNIA WILDCAT FAILURES

San Mateo County, Half Moon Bay area: The 3 E. T. Willard, 15-6s-5w, dry, TD 1,300 ft.

Ventura County, Camarillo area: Texas Co. 1 Broome, 29-1n-20w, dry, TD 3,821 ft.

Los Angeles County, Gardena area: Texas Co., Operator 9-1 Gardena Community, 36-3s-14w, dry, TD 10,085 ft.

Whittier area: Calumet Gold Mines Co. 1 Delaney Cinnabar, 24-2s-11w, dry, TD 1,276 ft.

Orange County, West Newport area: Amerada Petroleum Corp. 75-7 Irvine, 7-6s-10w, dry, TD 6,560 ft.

San Luis Obispo County, Cholame area: Buaas Development Co. 1 Jack, 19-25s-16e, dry, TD 3,400 ft.

Kern County, Sheep Springs area: Standard Oil Co. 56-33W W. P., 33-29s-21e, dry, TD 7,658 ft.

Edison area: Los Nietos Co. 1 Cauzza-Portals, 31-29s-29e, dry, TD 4,716 ft., top Santa Margarita 3,071 ft., Olcese 4,611 ft.

Round Mountain area: Confinental Oil Co. 1 M. & T., 33-28s-29e, dry, TD 2,745 ft., top Freeman 1,570 ft., Pyramid Hills 2,241 ft., Vedder 2,422 ft., Lower Vedder 2,642 ft.

Temblor area: Calumet Gold Mines Co. 2 FO/B, 31-29s-21e, dry, TD 3,012 ft.

OHIO, KENTUCKY

New Gas Pool Opened In Ridgeville Township

COLUMBUS.—The Ohio Fuel has opened up what looks like a gas pool in the south central part of Ridgeville Township, Lorain County, and 2½ miles south of the gas production in the northwest corner of the township. The completion is on Wm. Gilgenbach, Lot 26. Clinton sand at 2,477-85 ft. gaged 1,010,000 cu. ft. natural, and was tubed without shooting.

The first Medina sand gas well to be completed in the west half of Brush Creek Township, Muskingum County, was drilled in by the Ohio Fuel on 2 S. W. Carr, Section 25. Clinton sand at 3,889-3,930 ft. made 35,000 cu. ft. and the Medina at 3,988-95 ft. gaged 415,000 cu. ft. The well opens up a large area to possible Medina sand production.

Nineteen locations were reported for the week with Stark, Morgan, and Meigs counties each having three. The balance were scattered over nine counties with one wildcat in Cuyahoga County. Twenty-five wells were completed, Stewart, Mt. Vernon, Cambridge, and Ashland each having four.

OHIO SUCCESSFUL WILDCAT

Lorain County, Ridgeville Township: Ohio Fuel Gas 1 Wm. Gilgenbach, Lot 26, Clinton 2,477-85 ft., 1,010,000 cu. ft., TD 2,490 ft.

WESTERN KENTUCKY

OWENSBORO.—Carter Oil Co. last week announced location for a new Henderson County wildcat at the 1 S. E. Galloway, 8-O-23. Operators are building bridge and moving in materials at the present time and drilling is expected to start in the near future. No other new operations were announced during the week. Completions for the week totaled two, and consisted of a 118-bbl. oil well in Henderson County and a 110-bbl. oil well in Union County. No wildcat completions were noted.

Of the six wildcats carried on active drilling reports, none had reached critical depths at the close of the week.

EASTERN KENTUCKY

ASHLAND.—Kentucky-West Virginia Gas Co. finaled 4 gas wells in the eastern Kentucky area during the past week for an initial potential of 1,682,000 cu. ft. The completions included the 4,570 Alamander Caudill, Knott County, 119,000 cu. ft. from shale at total depth of 3,055 ft.; the 823 Polly Scott, Pike County, 74,000 cu. ft. from Big Lime at total depth of 3,244 ft.; the 5,678 W. Francisco, Pike County, 696,000 cu. ft. from Big Lime at total depth of 2,288 ft., and the 5,692 Robert Bates, Knott County, 793,000 cu. ft. from shale at total depth of 1,418 ft.

INDIANA

EVANSVILLE.—Indiana reported a relatively large number of completions during the past week, 14 wells being finaled. Six of these were oil producers and the remainder dry holes, two of the latter being wildcats. Only two new operations were announced during the week, both of them being in Gibson County.

A list of active wildcats included the Superior Oil Co. 1 John Hardiman, NW NE NW 18-2s-11w, Gibson County, which is waiting on cable tools to test shows of oil found in the McClosky lime at 2,271-41 ft. and 2,278-81 ft. On a 2-hour drill-stem test at 2,100-36 ft. in the Benoist sand 30 ft. of oil-cut mud and 240 ft. of salt water were recovered. A 1-hour drill-stem test of the McClosky at 2,270-84 ft. resulted in the recovery of 100 ft. of oil and 40 ft. of oil-cut mud.

INDIANA WILDCAT FAILURES

Posey County: Carter Oil Co. 1 J. C. Leffel, NW SE SW 28-6s-14w, dry at 2,985 ft., Glen Dean 2,198 ft., Cypress 2,500 ft., Ste. Genevieve 2,832 ft., McClosky 2,851 ft.

Calvert-Willis 1 Henry Rickens, NE NW 1-5s-14w, dry at 3,030 ft. in McClosky.

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A.A.P.G. Digests

(Continued from page 43)

of hollow oolites in the Lansing-Kansas City limestones below 3,050 ft. Some oil occurrences are due to porosity variations, but the most important reservoirs are anticlinal domes located above the summits of three pre-Cambrian hills. The largest dome has a closure of 50 ft. Structurally high tests flow initially. Reservoir energy is due to gas cap expansion followed by a dissolved gas drive and the encroachment of edge water. (3) Reservoirs in standstones associated with the unconformable contact of Pennsylvanian on Cambro-Ordovician and pre-Cambrian. These sand bodies, from 0 to 45 ft. thick, fringe three pre-Cambrian hills. They form stratigraphic traps with edge-water drive from which 50 tests produce at a depth of 3,350 ft. (4) Fractured pre-Cambrian quartzite at the summit of a buried hill, known to be producing in only one well at 3,315 ft.

The high percentage of dry holes within the Kraft-Prusa field is principally due to variations in the porosity of the Arbuckle dolomite. Many dry holes encountered sinkholes in the Arbuckle filled with slumped residual clays and cherts.

Radioactivity Logs in Limestone Reservoirs

V. J. MERCIER, Lane-Wells Co., Wichita, Kans.

THE principles and operation of well logging by radioactive means is briefly explained and reviewed by a new and novel demonstration technique. The fundamentals of interpretation of the radioactivity log are defined. The importance of correct measurements is brought out, and the "Collar Log" is introduced. The conclusions drawn will illustrate the advantages of logging by radioactivity in limestone reservoirs and in salt-contaminated areas.

The Geneseo Uplift—Rice, Ellsworth, and McPherson Counties, Kansas

STUART K. CLARK, C. L. ARNETT, and JAMES S. ROYDS, Continental Oil Co., Ponca City, Okla.

THE Geneseo uplift, Rice, Ellsworth, and McPherson counties, Kansas, includes the west half of Range 5 West and all of Ranges 6, 7, 8 West; Townships 17 to 21 South, inclusive.

Geologically it is the easternmost, semidetached lobe of the Central Kansas uplift. The structure on pre-Permian horizons is an ovoid uplift complicated by superimposed anticlinal folding. The principal period of folding was late Mississippian or early Pennsylvanian. The structure was further complicated by the regional tilting and recurrent uplift during post-Mississippian time.

Surface and subsurface rocks include beds of Quaternary, Cretaceous, Permian, Pennsylvanian, Mississippian, Ordovician, and Cambrian age, the latter resting unconformably upon the pre-Cambrian complex. The major gaps in this stratigraphic column represent, for the most part, periods of nondeposition.

Six oil fields and one gas field are associated with the Genesco uplift. As at September 30, 1946, these fields include a total of 768 wells yielding 14,471 bbl. per day. The fields have produced 47,771,212 bbl. of oil and approximately 13,500,000,000 cu. ft. of gas and are estimated to represent a reserve of 32,228,788 bbl. of oil and 400,000,000 cu. ft. of gas.

The Geneseo and Edwards oil fields and the Lyons gas field are anticlinal accumulations located on a sharp structural ridge which runs along the west edge of the Geneseo uplift. The principal producing horizon is the Arbuckle limestone, although in the Lyons field minor quantities of oil and gas are produced from the Simpson sand. The Wherry field, which produces from the Pennsylvanian basal (Sooey) conglomerate, and the Welch, Bornholdt, and Smyres fields, which produce from the Mississippi chert, are primarily stratigraphic accumulations and are located on the flanks of the uplift.

Moren-Kisinger Field, Young County, Texas

M. G. CHENEY, Coleman, Tex.

THE Moren-Kisinger field has several unorthodox features deserving the attention of those studying petroleum geology and well spacing.

The structural difference between the gas-oil contact in the area of closure and the oil-water contact at the northern end of the field is about 110 ft. Forty-five producing wells have been completed on the 400 acres of the north portion since discovery in 1929. Ultimate production is expected to reach 1,500,000 bbl. The Moren 1 discovery well in the south portion flowed 1,160,000 bbl. during the 10½-year period prior to interference from additional wells.

Its decline record indicated an ultimate yield of about 1,400,000 bbl., but the drilling of eight additional wells nearby, beginning October 1933, soon brought a cessation of its flowing life and termination of individual production record. The total yield from the nine wells is now about 1,860,000 bbl. and an ultimate of nearly 2,000,000 bbl. is indicated. Six of the additional eight wells had initial production of from 144 to 698 bbl. per day. All had producing-reservoir thicknesses about equal to that of the discovery well, the total

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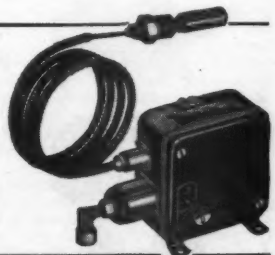

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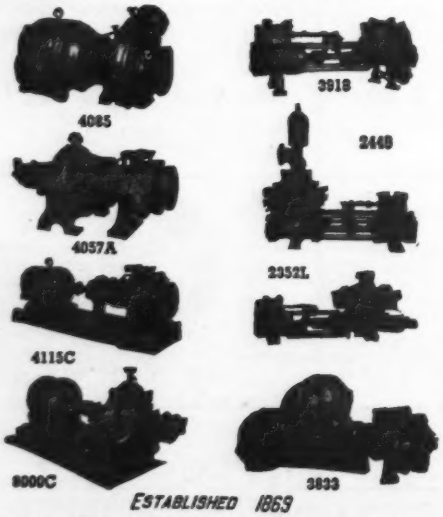

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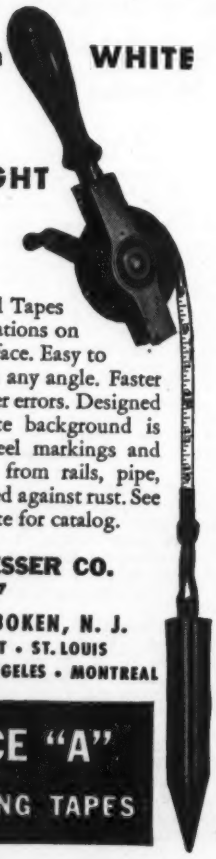

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sand interval averaging 50 ft. with estimated pay section of 40 ft.

Restricted flow with resulting efficient gas-oil ratio doubtless contributed to the rather phenomenal yield of the discovery well which seems to have produced a surprisingly large proportion of the total yield, in fact, a normal 80 to 100-acre yield from this sandstone reservoir which was sufficiently cemented to justify nitroglycerine shooting, operating chiefly under gas-drive control.

The Rangely Oil Field, Rio Blanco County, Colorado

W. Y. PICKERING and C. L. DORN, The California Co.

WELLS at Rangely encounter all of the Mesozoic formations common to this area and have penetrated a maximum of 1,500 ft. of beds referred to as Pennsylvanian. The structure is an asymmetric anticline on the northeast flank of the Uinta basin. Surface dips on the north flank are 3° to 4° while south flank dips of 31° have been measured. This fold has a total closure of about 1,600 ft. embracing approximately 60,000 acres. Production, however, is limited by the water-oil contact believed to be at a subsea datum of —1,160 which reduces the total area of accumulation to approximately 22,500 acres.

The Rangely field is in reality an old field rejuvenated by modern drilling practice and current demand for crude oil. Oil was discovered in the Rangely structure in 1902. First production was from the numerous fractured zones in the Mancos (Cretaceous) shale. Since its discovery, approximately 230 shallow wells have been drilled, roughly 45 per cent of which have been commercial producers yielding a total of 2,400,000 bbl. of oil. The deep Weber production was discovered in California Co.'s Raven "A-1" location in 1931. However, due to the inaccessibility of the region, small local markets, and uncertain well potential, extensive development was not undertaken until late in 1943. Since September of that year, a total of 185 wells have been completed in the Weber Sandstone which have produced a total of 6,300,000 bbl. to date. One well is also producing from a (Triassic) conglomerate called "Shinarump."

Hugoton Gas Field

L. C. MORGAN, consulting engineer and geologist; CALDWELL STARKEY, Stanolind Oil & Gas Co.; and R. K. LANYON, Phillips Petroleum Co.

THE Hugoton gas field is located in southwestern Kansas and extends across the Oklahoma Panhandle into the Texas Panhandle. Although the field has been previously described, because of much recent development, it is believed that further description is justified. An unusual occurrence of edge water on the west side of the field is structurally higher than the gas.

Geology of West Edmond Oil Field, Central Oklahoma

ROBERT MALCOLM SWESNIK, Anderson-Prichard Oil Corp., Oklahoma City.

THE historical geology of West Edmond field is considered in relationship to the entire Oklahoma City uplift. The sequence of deposition and structural movements is covered. Integrated into this pattern is the time of accumulation and the source of the oil of West Edmond field. Formation of the porosity of the Bois d'Arc was largely post-Hunton pre-Woodford and enhanced in post-Mississippian pre-Cherokee. There is evidence that it was formed by sub-aerial erosion. An old buried stream channel, the West Edmond valley, is of two consecutive ages, post-Hunton pre-Woodford and post-Mississippian pre-Cherokee, and this later gradient is computed at 8 ft. per mile. This valley, in furnishing a runoff for meteoric waters that seeped through the Frisco and the Bois d'Arc enabled these waters to greatly improve the permeability derived from primary porosity and later fracturing, so that they became a potential reservoir for oil.

Geophysical History of Guthrie Field, Logan County, Oklahoma

B. G. SWAN and W. B. BOYD, Continental Oil Co., Ponca City, Okla.

THE geophysical history of Guthrie oil field consists of a reflection seismograph survey in early 1938, a reinterpretation of these data in 1941, and a detailed reflection seismograph survey in 1941, after the discovery of oil, to outline dimensions of the structure more definitely. Early concern over the fact that Viola reflection times failed to show east closure on the structure was later dispelled when drilling developments showed that closure actually was not present on horizons above the second Wilcox sand.

Geology of Hunton Limestone Cores, West Edmond Field, Oklahoma County, Oklahoma

J. T. RICHARDS, Gulf Oil Corp.

DURING the drilling of the Gulf Oil Corp. 1 Streeter, SE SE 20-13n-4w, West Edmond field, a series of cores were taken from a point just above the top of the Hunton limestone into the Sylvan shale. A specially designed core barrel, using diamond-studded heads, recovered 96.5 per cent of the interval cored. The total thickness cored was 347½ ft.

All members of the Hunton were present, with the exception of one minor subdivision. The section is more complete than any known to outcrop in the state. One new member is added.

Lithologic Criteria for Subdivision Of the Arbuckle Dolomite in Far Western Kansas and Adjoining States

JOSEPH R. CLAIR and FANNY CARTER EDSON.

A FEW of the deeper wells in far western Kansas and adjoining states have penetrated completely beds commonly referred to the Arbuckle group, and have reached pre-Cambrian rocks. Examination of samples from these wells indicated that the pre-Chazyan, post pre-Cambrian beds, could be subdivided into units which could be recognized over the entire area and correlated from well to well.

Oil Possibilities of the Las Animas Arch and Adjacent Areas of Eastern Colorado

HARRY W. OBORNE, consulting geologist, Colorado Springs, Colo.

THE Las Animas arch is differentiated from the Sierra Grande arch in extreme southern Colorado and northern New Mexico. The former is a warped structure, while the latter is a platform or plateau area. Favorable stratigraphic and structural conditions for the accumulation of oil and gas exist with pronounced truncations, overlaps, and unconformities present. The area of sedimentary rocks of eastern Colorado contains approximately 28,000,000 acres and has had a wildcat well density of adequate tests of approximately one well to 2,000,000 acres. The Las Animas arch may be considered as comprising approximately 3,300,000 acres and has had a density of approximately one well to 1,000,000 acres. Only one well has actually been drilled on the axis of the arch.

Anadarko Basin Oil Possibilities

ROBERT R. WHEELER, Eason Oil Co., Enid, Okla.

FACTORS necessary for oil accumulation such as the creation of structural and stratigraphic traps, the distribution of porous reservoir rocks and their association with source beds are discussed with reference to the sequence of geologic events that initiated and later modified the Anadarko basin of western Oklahoma.

The oil objectives of the buried northwest-trending structures include the prolific Simpson sands, the newly proven Viola and Hunton limestones and the structurally and stratigraphically trapped early Pennsylvanian (Morrow) sands. Facies changes in the Ordovician, Mississippian, and possibly Morrow sediments created additional oil possibilities along the folded northern flanks of the basin.

In later Pennsylvanian time, rejuvenated movements of the Arbuckle and Wichita axes created additional, typically faulted, structures that further restricted the basin area. Facies changes in the erosion products added new reservoir possibilities. By Middle Permian time the basin was so restricted as to initiate evaporitic and red-bed deposition with relatively poor oil possibilities.

Antioch Oil Pool, Garvin County, Oklahoma

LON B. TURK, Oklahoma City, Okla.

SOUTHWEST Antioch oil pool, discovered in February 1946, had 28 producers, 3 dry hole, and 5 drilling wells as of December 15, 1946. This pool located in western Garvin County, Oklahoma, on the southwest flank of the Pauls Valley uplift, is a stratigraphic trap found at intersection of the third Deese sand (lower Marmaton) with the southwest dipping unconformity at base of Pennsylvanian.

The geological events that caused this stratigraphic trap are interrelated with history of the Pauls Valley uplift, which is a buried limb of the Arbuckle Mountains that crop out to the southeast. The Pauls Valley uplift, plunging westward has Ordovician sediments in contact with Pennsylvanian sediments (lower Missouri) at its truncated crest.

On west, north, and south flanks the unconformity at base of Pennsylvanian dips away from the crest at a rate greater than Pennsylvanian sediments above it; and at a rate less than the respectively younger sediments (Ordovician to Mississippian) that occur below it, away from crest of the uplift. Therefore, on these flanks all Pennsylvanian sediments older than Checkerboard limestone (covers crest of uplift) are found with updip wedge ends close to this unconformity, or else have terminated ends in contact with it; all pre-Pennsylvanian sediments are wedged out or terminated as they intersect this unconformity in successively younger order away from the crest.

Truncated Hunton formation (Devonian-Silurian) in the Southwest Antioch pool is found in a wedge-edge area with relationships of impermeable cover, unconformity at base of Pennsylvanian, local anticline, and southwest dip, being very similar to West Edmond field. One of the lower members of Hunton (Chimneyhill) has produced oil and gas in the Antioch pool, but not in commercial quantities. The Bois d'Arc member (Upper Hunton), source of principal production at West Edmond field, has not yet been found on the west flank of the Antioch pool.

The name "Gibson sand" is proposed for the Third Deese sand, only horizon found productive to date.

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Among the

Drilling Contractors

Meredith, Clegg & Hunt, Houston, are rigging up to drill Southern Minerals Corp. 1 Isensee, in Lot 9, BS&F Survey 407, southwest of the Saxet pool in Nueces County, Texas. Contract depth is 7,500 ft.

H. & S. Drilling Co. is the name of a new drilling firm which has been organized by Hohn M. Winters, Jr., Rogers S. Randolph, and Joe M. Holliman, all of Tulsa.

Gabbert & Lindas Drilling Co., Wichita, has taken over operation of the 1 Bunker Hill, in SE SE NE 26-14-13, Russell County, Kansas, from Leon Wondra, of Lincoln, Neb. The hole is bottomed at 2,961 ft. in the Lansing and operators are attempting to squeeze off water and take a cable-tool core. A show of oil was reported at 2,960 ft.

Kiowa Drilling Co. has started operations at the 1 Frankum, in NE NE NW 32-31-1w, an attempted west extension to the Wellington pool of Sumner County, Kansas.

Ben Brack, Wichita, has been awarded drilling contract on the Anderson-Prichard Oil Corp. 1 Bertrand "C," a wildcat test for which location has been staked in NE NW SE 19-27-4w, 22 miles west of Wichita on the western edge of Sedgwick County, Kansas, and 8 miles southwest of the Hilger pool of Reno County.

Zephyr Drilling Co. has acquired a spread of leases to increase interest in the play several miles northeast of Lexington in southern Cleveland County, Oklahoma.

Smith-Horton Drilling Co. will drill a wildcat 3 miles north of Castle and several miles northwest of Okemah in Okfuskee County, Oklahoma. It is the 1 Weldon, in SW SW NE 17-12n-9e, in an area dominated by Amerada Petroleum Corp. The test is 1½ miles west of the four-well Castle pool in 15-12n-9e.

Nelson Drilling Co. and **Charles Seany** have staked location for the 1 Peters in SE SE NE 4-20s-1e, a wildcat in Marion County, Kansas. It is approximately 2 miles south of the LeHigh pool.

Mercury Drilling Co. and **Danciger Oil & Refining Co.** have been delayed in the testing of their joint wildcat, 1 Shaffner, SE NE SE 7-13n-6e, Lincoln County, Oklahoma, by the strike of cable-tool workers in East Central Oklahoma areas. The well was swabbing at the rate of 1 bbl. of oil an hour from pay sand at 4,400-40 ft.

Crew of the Lotland Brothers No. 129 rig, at the 1 Clark, Garden City, Tex. Standing at left is L. C. Clark, landowner. Crew members, front row: T. M. Ocheltree, engineer for Shell Oil Co., Inc.; Kenneth R. Wheeler, backup man; Clifton Green, derrick man, and Ralph A. Martin, motor man. Back row: Paul H. Meyers, tool pusher; John P. Cheers, driller; R. A. White, lead tongs, and Loyd G. Luindell, pipe racker

when work was suspended. When work is resumed, the hole will probably be shot or acidized in an effort to increase the rate of production. The Simpson dolomite was encountered at 4,390 ft. and the Wilcox at 4,408 ft.

Hartman & Jordan Drilling Co., Mount Vernon, Ill., is drilling contractor on the Carter Oil Co. 1 Josephine Gempler et al and F. Oeth, in SE SE 36-6s-14w, Posey County, Indiana.

F. C. Hall has contract for the Wilcox sand test projected by R. C. Holt, location for which has been staked in SW SW NW 34-14n-1e, in eastern Oklahoma County, Oklahoma. The test will be the 1 Rinehart. O. M. Cole and Eli Bernstein assembled the 100-acre block after geological work by Clyde Dorr.

John Unger, Salem, Ill., is drilling contractor on the Ernest Zink 2 Indiana Defense Relocation Corp., in SW NE 19-2n-10w, Knox County, Indiana.

Kiowa Drilling Co. will attempt to extend the Wellington pool of Sumner County, Kansas, to the west with the 1 Frankum, NE NE NW 32-31-1w. Rig is up for the test and drilling operations are expected to begin immediately.

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Safety Film to Be Made

DALLAS.—The U. S. Bureau of Mines, in connection with the American Association of Oilwell Drilling Contractors, will shortly make a motion picture featuring safety in drilling practices. Locations will be on the Gulf Coast and in West Texas, and the film will cover all types of drilling operations, according to Brad Mills, executive vice president of the association.

Half Interest in Lease Given as Year-End Bonus

A year-end bonus consisting of a half interest in a newly bought 800-acre lease in Garza County, Texas, has been given its 100 employes by General American Oil Co. of Dallas. The lease contains 23 wells and was purchased for $425,000.

A. H. Meadows, General American president, said the employes' estimated monthly income of $10,000 will go into a trust fund from which distribution will be made on a basis of length of service and position with the company.

At Houston directors of Tennessee Gas & Transmission Co. announced a general wage and salary increase of 15 cents an hour for hourly employes and a corresponding increase for salaried employes. Gardiner Symonds, president, said the voluntary increase was made because of increased costs of living and because of unusual demands which have been made and will continue to be made on the entire organization.

Cooper Petroleum Wins OPA Overcharge Suit

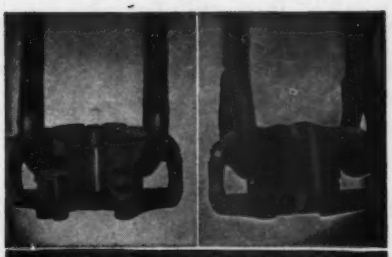
HOUSTON.—Cooper Petroleum Co. has won a federal court decision deciding in the company's favor a suit brought by the now defunct Office of Price Administration for more than $35,000 alleged overcharges in sales of petroleum products.

The decision announced by Federal District Judge T. M. Kennerly held for the company on all points at issue in the case. The suit was tried in Houston last September.

Increase Given Lone Star

AUSTIN. — The Texas Railroad Commission last week gave Lone Star Gas Co. an emergency increase of 60,000,000 cu. ft. daily in its allowable gas production from Carthage field to help supply the Big Inch pipe lines.

The excess, the commission order ruled, will be charged against Lone Star's February production. Carthage field, in Panola County, had an original January allowable of approximately 500,000,000 cu. ft. daily.



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PERSONALS

Sun Vice Presidency Latest Promotion For John Pew

PROMOTION to vice president in charge of production for Sun Oil Co. is the latest of many steps upward for John Glenn Pew, 44, who entered the oil business in 1916 as an office boy for Carter Oil Co. in Tulsa. Pew, who was named a director and assistant to the vice president in charge of production in 1941, succeeds his father, J. Edgar Pew, who died in November.

Pew began his oil career by working during summer vacations. He joined Sun in full-time capacity after leaving Massachusetts Institute of Technology in 1924. Previously he had attended Southern Methodist University and Cornell University.

In his vacation work, Pew had served with a geological crew, as a stockroom boy, in the accounting department, as a routabout, and on a crude-oil tank-car loading rack. In 1925 he worked at Wortham, Tex., as warehouseman and timekeeper in Sun's production department. Later in the year he was transferred to the land and scouting department. Later he became state agent in Texas, supervising all leasing, scouting, buying, and selling of oil, and construction.

In 1926 he was transferred to Dallas as a member of the land department. In 1938 he was appointed to a three-member committee which managed the oil operations of the Dallas division, in which capacity he served until his appointment as assistant to the vice president in charge of production in 1941. Pew also has been made president of Sun Pipe Line Co. (Texas).

J. E. Chapman has been promoted from master mechanic to mechanical superintendent with Pan American Pipe Line Co., Houston.

H. W. Mathews has been appointed division production superintendent for Standard Oil Co. of Texas at Midland. **R. W. Harrison** has been appointed chief engineer for the company at Houston.

Thomas Burke, cost accountant in the Ponca City, Okla., refinery of Cities Service Oil Co., has resigned to accept a similar position with Arabian Oil Co. He will be stationed in Saudi Arabia.

Connie Wilson, Jr., engineer with Cities Service Oil Co., has been transferred from Oil Hill, Kans., to Bartlesville, Okla.

J. E. Rouse and **George W. Clarke** have been elected directors of Stanolind Oil & Gas Co. Rouse, former manager of the manufacturing department, will be in charge of production and manufacturing. Clarke, manager of the exploration department, will be director of exploration, in a reorganization of some executive duties.

H. D. Henderson, land man for Sohio Petroleum Co., has been named head of the land department of the newly created Gulf Coast division with headquarters in Houston.

Dr. Cecil L. Brown, director of the Esso Laboratories of Standard Oil Co. of Louisiana, has been elected a councilor-at-large of the American Chemical Society. Brown will serve 3 years on the council, the society's advisory body, on policy and general management.

W. T. Holliday has been elected chairman of the board of directors, and **William J. Loufman,** president, of Fleet Wing Corp., subsidiary of Standard Oil Co. (Ohio), of which Holliday is president.

Vic Fischer, geologist with Shell Oil Co., Inc., at Shreveport for the past 10 years, has resigned to become affiliated with the C. H. Murphy interests in El Dorado, Ark.

Frank K. Lewis, Midland, Tex., has been elected vice president, and **William E. Lester,** Wichita, Kans., treasurer, of Bridgeport Oil Co., Inc., Wichita, an interest in which was recently sold to Cooperative Refinery Association.

Harold G. Picklesimer, geologist formerly with Arkansas Fuel Oil Co., has joined Sunray Oil Corp. **Leroy Cockrell,** also formerly with Arkansas Fuel, has joined Sunray as a land man.

E. F. Fullen, former production foreman in charge of Olive field in Hardin County, Texas, has been appointed district superintendent for Pan American Production Co. with supervision over all production-department operations in a newly created Southeast Texas district including seven counties.

J. B. Harsham, general manager of Stanolind Pipe Line Co., transportation subsidiary of Standard Oil Co. of Indiana, has been elected to the board of directors. In other advancements, **B. W. Russell** was made traffic manager and **R. W. Bolian** assistant traffic manager.

R. H. Stark has retired as superintendent of transportation for Gulf Oil Corp. to end a 40-year career in oil transportation. Stark joined J. M. Guffey Oil Co. in 1906 in the pipe-line department. The company later was absorbed by Gulf. In 1919 he entered Gulf's warehouse department in Louisiana as storekeeper and in 1920 was moved to Houston with the transportation department where he remained until his retirement.

Col. G. H. Vogel, executive officer of Army-Navy Petroleum Board; **Walter B. Pyron,** vice president of Gulf Oil Corp. in charge of Gulf's London office; and **Andrew T. Carter,** president of Overseas Tankship Corp., left New York on the Queen Elizabeth last week for London. Vogel expects to visit Germany and Italy before returning to the United States. Overseas Tankship is a California Texas Oil Co., Ltd., affiliate.

Willard C. Asbury, E. Duer Reeves, and **William J. Sweeney** have been elected vice presidents and directors of Standard Oil Development Co.

Dr. Paul Zurcher, research chemist and technologist with Continental Oil Co. for nearly 20 years, has joined the faculty of the University of Tulsa as associate professor of petroleum refining, effective upon the opening of the second semester January 27.

Sam W. Cobb, civil engineer, has retired after more than 20 years' service with Barnsdall Oil Co.

H. E. Brandli has been appointed vice president and general manager of Cities Service Oil Co. (Pa.). He formerly was vice president in charge of export and wholesale sales. He joined Cities Service in 1912. He is a director of Petroleum Advisers, Inc., and vice president and director of Oil Trades Association.

WALTER L. FAUST

Walter L. Faust, vice president and director of Socony-Vacuum Oil Co., Inc., and formerly in charge of the firm's domestic-marketing activities, has been placed in charge of the company's foreign-marketing operations. He also will assume chairmanship of the foreign-trade committee. He will be succeeded by **A. L. Nickerson** as head of domestic-marketing operations.

O. F. Beaty, district landman for Magnolia Petroleum Co. at Great Bend, Kans., is being transferred to Amarillo, Tex., to succeed **John Van Dale,** who is retiring.

Morris Pittman, drilling superintendent for Creole Petroleum Corp. in the Jusepin area, is on leave of absence in the United States. He went to Venezuela in 1940 and previously was drilling superintendent for Humble Oil & Refining Co. in Means field, West Texas.

William Crutcher has been transferred from the Illinois office of Carter Oil Co. to become division chief scout for the company at Billings, Mont. He succeeds **Joe C. Kahl,** who recently was named chief scout for Carter and transferred to Tulsa.

Buell O'Connor succeeds **George Roberts** as chairman of the Tulsa chapter of the American Chemical Society. O'Connor and Roberts are both with the research department of Stanolind Oil & Gas Co. **Dr. Paul Cardwell,** Dowell, Inc., has been appointed vice chairman.

Francis S. McIlhenny, Jr., has been elected secretary-treasurer and a director of Sun Oil Co., succeeding the late Frank Cross. McIlhenny, 36, graduate of Princeton University and University of Pennsylvania law school, has served as assistant secretary and assistant treasurer since leaving the Navy. He joined the company's treasury department in 1939.

H. B. Nichols, former assistant vice president of Bahrein Petroleum Co., Ltd., has been named a vice president in charge of manufacturing, research, and development.

R. H. Stark last week resigned as superintendent of transportation for Gulf Oil Corp. after 36 years of service with the concern.

James L. Morris, geologist, Pure Oil Co., recently was transferred back to the Texas producing division at Fort Worth from an assignment in Wyoming and Montana.

W. M. Shepperd, gas and gasoline department of Pure Oil Co., Van, Tex., received his 35-year pin January 1 for continuous service with the company.

William R. Carlisle, vice president and director of Standard Oil Development Co., has been appointed associate general counsel of Standard Oil Co. (N. J.). He joined the development company as legal assistant to the president in 1930.

Kenneth A. Ackley, assistant to **Carl Herrington,** Eastern Division superintendent for Carter Oil Co., has been appointed exploration manager of that division. **Lee C. Lamar,** division geologist, is being transferred to the Tulsa geological office and will be succeeded by **R. M. English,** assistant division geologist.

James B. Burt has returned to Saudi Arabia for Arabian American Oil Co. Burt is a former resident of Kermit, Tex., and was associated with Magnolia Petroleum Co.

C. V. Stinchecum, who has been in charge of Magnolia Petroleum Co.'s land office at Duncan, Okla., is retiring to enter the brokerage business. Magnolia's Duncan office will be closed and its work handled by its Oklahoma City offices.

Herman R. Hauptman, Jr., has been sent to South America for several months' foreign work by Schweer and Hardison, petroleum geologists. He formerly was a field geologist with Shell Oil Co., Inc.

C. A. Lutz, petroleum engineer for Stanolind Oil & Gas Co., has been transferred from the company's Panhandle area to the Brownfield (Tex.) area. **James C. Farris,** junior engineer, replaces Lutz in the Panhandle.

Shifts

Roy J. Miller, engineer, Velsicol Corp., Long Beach, Calif., to Denver; **Lloyd N. Johnson,** engineer, Magnolia Petroleum Co., Crane, Tex., to Lawrence, Kans.; **E. W. Childers,** engineer, Tide Water Associated Oil Co., Victoria, Tex., to Starke, Fla.; **Victor Bychock,** foreman, Atlantic Refining Co. Big Lake, Tex., to Andrews, Tex.; **Herbert V. Lee,** geologist, The Texas Co., Corpus Christi to Barranquilla, Colombia.

G. W. Blackburn, superintendent, Woodley Petroleum Co., Midland, Tex., to Abilene, Tex.; **A. B. Wicks,** superintendent, Humble Oil & Refining Co., Franklin, La., to Maringouin, La.; **F. W. Briggs,** foreman, Continental Oil Co., Ruston, La., to Homer, La.; **S. P. Morris,** superintendent, D. D. Feldman, Jennings, La., to Almeda, Tex.; **Oscar Stevenson,** foreman, Sun Oil Co., Woodlyn, Pa., to Chester, Pa.

Hamilton B. Caskie, engineer, Pittsburgh, Pa., to Carbon Hill, Ala.; **R. E. Mitchell,** engineer, Shell Oil Co., Inc., Tipton, Ind., to Pampa, Tex.; **W. S. McCready,** engineer, Phillips Petroleum Co., Eureka, Kans., to Ardmore, Okla.; **James T. Grady, Jr.,** engineer, The Texas Co., Wichita, Kans., to Tulsa; **Richard W. Love,** engineer, The Texas Co., Ellinwood, Kans., to Wichita, Kans.; **Thomas W. Bibb, Jr.,** geologist, The Texas Co., Seattle, Wash., to Bakersfield, Calif.

Earl M. Casey, superintendent, Mackinnie Oil & Drilling Co., Elk Basin, Wyo.; to Powell, Wyo.; **W. T. Van Ravenswaay,** engineer, Phillips Petroleum Co., Bartlesville, Okla., to Phillips, Tex.; **John H. N. Evinger,** engineer, Gulf Oil Corp., Grove, Okla., to Key West, Fla.; **Wayne Coffman,** engineer, Cities Service Gas Co., Guymon, Okla., to Bartlesville, Okla.; **H. M. Houghton,** engineer, Geotechnical Corp., Lawton, Okla., to Tulsa.

J. P. Jones, engineer, Standard Oil Co. of Texas, Gainesville, Tex., to Falfurrias, Tex.; **R. W. Irwin,** engineer, Salt Water Control, Inc., Houston, to El Campo, Tex.; **Jaime Amorocho,** engineer, The Texas Co., Midland, Tex., to Vernon, Tex.; **A. N. Eby,** engineer, Superior Oil Co., Abbeville, La., to Houston; **Richard A. Pohly,** geologist, Global Exploration Co., Haynesville, La., to Houston.

Equipment Men in the News

Clark Bros. Adds to Company Officials

At a recent meeting of the board of directors of Clark Bros. Co., Inc., Olean, N. Y., the following members were added

F. H. LIGHT

J. N. MACKENDRICK

to the present roster of company officials: F. H. Light, vice president, treasurer and

D. K. HUTCHCRAFT

F. W. LAVERTY

secretary; J. N. MacKendrick, vice president in charge of engineering; D. K. Hutchcraft, vice president in charge of sales, and F. W. Laverty, general sales manager.

Lincoln Appoints Sharp Indianapolis District Manager

Lincoln Electric Co., Cleveland, has appointed R. W. Sharp as district manager and sales engineer of its new Indianapolis office which has been established at 3343 Central Avenue. He was covering the Kentucky and southern Indiana territory for the company at the time he joined the Navy and prior to that was assigned to the Columbus office.

McKee Elects Moorhouse And Krumhansl

At a special meeting of the board of directors of Arthur G. McKee & Co., Cleveland, December 23, R. E. Baker's resignation as of January 1, 1947, as secretary and treasurer of the company was accepted by the board. The directors elected two officers to fill the vacancies created by the resignation. H. R. Moorhouse was elected secretary and James Krumhansl treasurer.

Gulf Coast Changes in Lane-Wells

Morton T. Higgs, formerly Gulf Coast division manager of Lane-Wells Co., has been appointed to the newly created position of manager of field operations and will make his headquarters in Los Angeles, according to Rodney S. Durkee, president. John J. Neale, formerly Gulf Coast division sales manager, has been advanced to the post of Gulf Coast division manager. C. F. Ludwig, formerly assistant division operating superintendent, succeeds Neale as division sales manager. H. W. (Pat) Hillebrandt, formerly district operating superintendent at Shreveport, succeeds Ludwig. K. K. (Shorty) Gage, formerly assistant district operating superintendent at Shreveport, succeeds Hillebrandt. H. W. Greene, formerly subdistrict superintendent at Lake Charles, succeeds Gage. Dan H. McLendon has been appointed subdistrict superintendent at Lake Charles. O. J. Guseman has been made assistant district superintendent at Houston. C. R. Searcy has returned to the engineering department in Houston, and Tom W. Lindsey is the new subdistrict superintendent at Victoria.

Smith and Yancey Form Corporation

Roger Smith and J. R. (Dick) Yancey have announced the formation of Smith-Yancey Corp. The new firm began operations January 1, with offices and plant at 3820 Winchester Street, Houston. Smith, president of the new firm, has been with Gray Tool Co. for the past 20 years and was vice president and director when he resigned December 1. Yancey, vice president and general manager for the past 3 years, has been vice president and chief engineer of A-1 Bit & Tool Co., and for 13 years prior to that was chief engineer and then vice president of Gray Tool Co. Roger Smith, Jr., secretary-treasurer of the firm, is a veteran of World War II.

Emsco and Youngstown Steel Hold Party

Emsco Derrick & Equipment Co. and The Youngstown Steel Products Co. of California held an informal buffet supper December 17 at the Ambassador Hotel, Los Angeles. Guests included oil men, equipment men, and various publication representatives.

Gelin Heads Lear International

Lazare Gelin, who served as export manager of Lear, Inc., Grand Rapids, heads a new organization which will carry on all of Lear's export work, according to William P. Lear, president. The organization, with Gelin as president, will be known as Lear International Export Corp., with headquarters at 50 Broad Street, N. Y.

LAZARE GELIN

New Vice Presidents in Mathieson Alkali

The board of directors of Mathieson Alkali Works has elected D. W. Drummond and Arthur T. Bennett as vice presidents, it is announced by George W. Donal, president. Drummond's new title will be vice president-general manager of sales, and Bennett's, vice president-general manager of operations.

Wolfe Distributor for FWD

The Four Wheel Drive Auto Co. announces the appointment of Wolfe Distributors, 706-708 Northwest Second Street, Oklahoma City, as authorized sales and service representatives for the complete line of the company's trucks in Central and western Oklahoma.

Vance Vice President of Fort Worth National

At a meeting of the board of directors of The Fort Worth National Bank, December 27, Estil Vance, Texarkana, Tex., was elected vice president, it is announced by R. E. Harding, president of the bank. Vance is now vice president of the State National Bank, Texarkana, with which institution he has been actively associated since 1929.

Ryerson Appoints Kinzie To West Coast Post

Joseph T. Ryerson & Son, Inc., Chicago, announces appointment of Freeman X. Kinzie as West Coast representative of the bearings and babbitt division. He will make his headquarters at the company's Los Angeles plant located in the central manufacturing district. Kinzie, who has represented Ryerson in the Chicago and St. Louis areas for a number of years, succeeds O. K. Graef, whose resignation become effective November 1, 1946.

F. X. KINZIE

Schwanhausser Reelected D.E.M.A. President

E. J. Schwanhausser, vice president of Worthington Pump & Machinery Corp., was reelected president of the Diesel Engine Manufacturers Association at the association's annual meeting held December 11 in Chicago. Returned to their posts as vice presidents of the association were: J. E. Peterson, vice president of General Machinery Corp., and Gordon Lefebvre, president of The Cooper-Bessemer Corp. Robert H. Morse, Jr., vice president and general sales manager of Fairbanks, Morse & Co., was again chosen to serve as treasurer. Directors were elected as follows: William E. Corrigan, vice president of American Locomotive Co.; George W. Codrington, vice president of General Motors Corp. and general manager, Cleveland Diesel Engine Division; A. W. McKinney, vice president and general manager of sales, National Supply Co.; Robert E. Friend, president, Nordberg Manufacturing Co.; Norris H. Schwenk, president of Busch-Sulzer Brothers-Diesel Engine Co., and G. F. Twist, vice president and general manager, Atlas Imperial Diesel Engine Co. Harvey T. Hill, who for 3 years has been executive director of D.E.M.A., was appointed to continue in that capacity.

Hough Appointed District Administrator

A. O. Smith Corp. announces that George P. Hough has been appointed executive administrator of the company's Chicago district, succeeding Don T. Allen who resigned recently.

Seismograph Party to Bahamas

James A. Ballard, party chief; James H. Smith, driller, and James E. Baskin, surveyor, are on a trip to the Bahama Islands for Seismograph Service Corp., Tulsa, to prepare for operations of a seismograph party to survey for Anglo-Bahamian Petroleum Co. early this year.

Brindel Joins Foxboro

Frank D. Brindel, formerly with Crane Co., Tulsa, has joined Foxboro Co. as sales engineer and will be located in Tulsa following factory training.